The Underdetermination of Interdisciplinarity: theory and curriculum design in undergraduate higher education

David Morrison

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School of Education
College of Social Sciences
University of Glasgow

Abstract

Interdisciplinarity in higher education is a widely used but poorly understood term. There is a wealth of literature about the topic, but beneath the surface details very little of it agrees. Further, what attempts have been made to engage with pedagogies of interdisciplinarity in the undergraduate curriculum often suggest dubious programmes of 'minimal understanding' or 'adequacy'. These are consistent only in their inconsistency and lack of standard qualifications, and are often short lived. This thesis explores why there is no consensus on interdisciplinarity, and why there is no consistently effective undergraduate curriculum to develop it, and seeks to resolve both questions via a range of empirical evidence from fields which have not heretofore been applied to interdisciplinarity research.

Three problems are identified in the current research: self-contradictory pedagogic models; a general lack of reliable evidence for theories; and a lack of engagement with relevant educational and psychological research. Taking a pragmatic approach to evidence I review the existing educational research on disciplinarity and the psychological research on expertise, knowledge transfer, collaborative cognition and categorisation to see if these can yield more consistent and empirical foundations for an understanding of interdisciplinarity. The culmination of this research soundly undermines several of the persistent but ill-evidenced models of interdisciplinarity in the literature, namely pluralism, disciplinary essentialism, and competency-based models, and establishes a more coherent approach to interdisciplinary curricula.

Taking the view that a model is not complete without connection to practice, I have also interviewed current academics in the 'interdisciplinary' field of Medieval Studies to correlate the psychological evidence with praxis. Ultimately, interdisciplinarity as a 'thing' or a stable academic identity is refuted in favour of interdisciplinarity as a particular focus of skills-based curriculum. This focus should ideally be developed concurrently with matching skills in a disciplinary context in order to balance breadth and depth of learning. This thesis ends with some forward-thinking considerations of curriculum models which could facilitate a balanced disciplinary and interdisciplinary approach in practice.

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Special thanks must go to my wonderful partner Jane, who has more than merely tolerated my ramblings and ravings, but has been supportive beyond all measure. She has always listened if I needed to get ideas out, whether she understood or not, and has always tried to learn what I am doing and offer critical responses. Never once in three years was I told to go work somewhere else. For sticking by me every minute, even marrying me instead of running away, I am more grateful than words can express.

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Declaration

I declare that, except where explicit reference is made to the contribution of others, that this dissertation is the result of my own work and has not been submitted for any other degree at the University of Glasgow or any other institution.

Signature _____

Printed name _____

Abbreviations

RoI	– Research of Interdisciplinarity
AIS	– Association of Interdisciplinary Studies (formerly Association of Integrative Studies)
HTRoI	– Historio-Theoretical Research of Interdisciplinarity
SoITL	– Scholarship of Interdisciplinary Teaching and Learning
RoIR	– Research of Interdisciplinary Research
ERoI	– Educational Research of Interdisciplinarity
OECD/CERI	– Organisation for Economic Co-operation and Development / Centre for Educational Research and Innovation
SCQF	– Scottish Credit and Qualification Framework
QAA	– Quality Assurance Agency (for Higher Education)
KIS	- Key Information Sets
IDS	- Interdisciplinary Studies
NSS	- National Student Survey
IDS	- Interdisciplinary Studies

Introduction

"A serious lack of discipline in the use of terminology has hampered progress in analysing the Sociology of interdisciplinary and multidisciplinary organizations. There is no agreement on what a discipline is, let alone what distinguishes terms such as inter-, multi- or crossdisciplinary from each other" (Rustrum 1979: 169).

"This is one in a long series of efforts of governments to constantly recreate the conditions of innovation, and in that context has very short-term goals. My position is that anything that gets hyped up in this way needs critical attention…[Interdisciplinarity is] a perversion of something that could be valuable" (Strathern 2005: 134).

These quotes suggest that a general understanding of interdisciplinarity, its value, or even its existence is hardly a foregone conclusion; in fact the situation may be getting worse rather than better over time.

Research Questions

There are two primary research questions this thesis seeks to answer:

- What is interdisciplinarity best defined as, in terms that are consistent in practical application *and* learning and teaching?
- What types of undergraduate curricula can best develop interdisciplinarity?

These questions necessitate a sub-question, which this thesis will also seek to answer:

- What is a discipline, in terms that allow for a clear and useful understanding of interdisciplinarity?

This thesis aims to return to the foundations of interdisciplinary theory and research to enable the identification of a solid but highly flexible structure to develop interdisciplinarity in the undergraduate curriculum *without* sacrificing disciplinary expertise. This will be achieved through critical review of the gaps in existing models, analysis of heretofore underexplored research in psychology on constraints of learning, and

triangulation of these with interview-based analysis of current practice in the field of Medieval Studies.

The focus on the nature of interdisciplinarity was not the original goal of this thesis. It began with a narrower goal, one specifically derived from my undergraduate and Masters work in Scottish Medieval Studies. I was interested to know why serious interdisciplinary discussion seemed not to begin until the postgraduate level, while there appeared to be far more time to teach such apparently foundational things during the longer undergraduate period. The chief reason that I deviated from this plan was that in looking for a model of interdisciplinarity to adopt for the project I was struck not only by how little coherent agreement on the term there was, but that what agreement there was came through rhetorical and uncritical applications of a few select authors (whose work often appeared problematic and less than compelling). It seemed necessary and useful then to take the concept of interdisciplinarity back to first principles.

Though I enter into this thesis from personal experience which suggests interdisciplinarity to be real and valuable, I regard this as a hypothesis to be tested, not a fact to be explained. Therefore in the review that follows I have not presumed that any account of the nature of interdisciplinarity is valid beyond what evidence is provided. This has led to a problematising of much of scholarship on the subject to date, and the realisation that I am not alone in coming to this conclusion (Lattuca 2001; Nikitina 2005; Spelt *et al.* 2009; Huutoniemi 2012). My review revealed both some welcome and unsettling trends, and established not only why it is necessary to try yet again to develop an understanding of interdisciplinarity, but what elements may need to be addressed most.

I will consider below several different traditions of research on interdisciplinarity. Within these, many definitions of interdisciplinarity have been given over the past 40 years, and aside from a few surface similarities there has been little consistency or commensurability between them. Definitions which have shared some limited consensus seem to have done so by evolving over several decades to become increasingly long, vague, and with more *ad hoc* clauses, until it is not clear that they define anything (Apostel 1972; Newell and Green 1982; Thompson-Klein 1990, 1996, 2010b; Lattuca 2001; Newell 2001; Rowland 2006; Boix-Mansilla and Duraising 2007). One of the most regularly cited definitions of interdisciplinarity in recent publications is:

> "the capacity to integrate knowledge and modes of thinking in two or more disciplines or established areas of expertise to produce a cognitive advancement – such as explaining a phenomenon, solving a problem, or creating a product – in ways that would have been impossible or unlikely through single disciplinary means" (Boix-Mansilla and Duraising 2007: 219).

In addition to being broad enough to encompass a suspiciously large range of activities, the separate elements of this definition are themselves ill-defined and open to considerable debate.

Rather than proceed with an assumed definition of interdisciplinarity, I will look at what has been claimed as interdisciplinarity in the literature, whether or not it is defined directly, in the hope that a better definition will become clear. I take as my starting point two core questions, which directly challenge most (but not all) of the existing literature on interdisciplinarity:

- What if none (or very few) of the historical cases of interdisciplinarity frequently used in the literature to define interdisciplinarity actually are so?

- What if academics within the disciplines who claim to do be doing interdisciplinary work are not reliable sources for knowing whether they are or are not?

If the answer to each of these were true, which is often the case, it suggests that interdisciplinarity may be a chimera, a mythical creation of the modern era of education theory: I could end this thesis now by suggesting that there is simply no interdisciplinarity, and some have done just that (Fish 1989; Dogan and Pahre 1990). However, there is sufficient evidence in the literature on interdisciplinarity to suggest that *something* is consistently happening in practice which transcends, undercuts, sidesteps or blurs what is typically presumed to be disciplinary activity. Whether interdisciplinarity is the best term for this is debatable, but it is the term we are offered. I am sceptical of much of the evidence given to validate interdisciplinary theory, but also the too-easy response that it just doesn't exist. My research agenda then has been to locate and evaluate an alternate source of defining interdisciplinarity and developing a practical undergraduate curriculum for it, ideally a source which is situated or focused outside of disciplinary and interdisciplinary concerns themselves. My approach to this follows a strongly pragmatic epistemology.

As we will see many, if not most, of the reliable aspects of defining interdisciplinarity are fairly straight-forward, and have indeed been tacitly 'floating around' in the literature in some form for many years. However, the tacit or common sense nature of these ideas is often the problem. Because there has been limited focus on reliable evidence over rhetoric in the literature, claims that are sensible have typically stood on equal or lesser footing with claims which are less sensible or even detrimental. My interest is in uncovering what claims can be justified and in problematising those which cannot, in the hope that this will lead to a more reliable, applicable and sustainable concept of disciplinarity and interdisciplinarity.

Before looking further at the structure of the thesis, it is important to elaborate on two key terms which form a backbone of the approach to knowledge taken here.

Core Terms

Underdetermination

Underdetermination is a core theme of this thesis. This is a term devised within the pragmatic epistemological tradition for the idea that a theory may fit all of the evidence at hand, but may not resolve whether it is the only, the *best*, or even a good solution (Quine 1969; Stanford 2013). This can be because the justification for the theory itself is not explored (such that it is considered self-evident or that it has transactional value), but more often it is because the comparative value of the theory is not considered next to other theories which also fit the same evidence.

I identify two types of underdetermination, one which is essential to all knowledge and cannot reasonably be eliminated, which I refer to as 'justified', and one which can reasonably be eliminated or reduced, which I refer to as 'unjustified'.[1] The first type states that we can never be entirely certain that there *cannot* be a better theory which we are simply unaware of yet. This type presumes that every reasonable effort to look for such a theory has been exhausted using present abilities. The second type, unjustified underdetermination, occurs when the second condition of justified underdetermination is not met, i.e. when alternate theories or evidence are reasonably available but are not engaged with. That these alternate theories or evidence must be *reasonably* available

[1] I use 'justified' here in the sense that epistemological knowledge is most commonly referred to as 'justified true belief'

suggests that this cannot be an absolute judgement; what is reasonable from one perspective may not be so from another. As such, simple epistemological tricks of contrariness such as stating ‘this only applies in the cases you have seen’ are not sufficient to call a theory unjustifiably underdetermined; one must present a compelling argument that the underdetermination in question could be reasonably reduced. One of the key arguments of this thesis is that alternate theories and evidence about interdisciplinarity have been reasonably available for some time, and have not been engaged with, making much of the current state of interdisciplinary theory unjustifiably underdetermined. This in turn has a direct impact on effective curriculum models for interdisciplinarity, or the lack thereof.

One other key point is that unjustifiably underdetermined theories are not presumed to be incorrect *merely* by virtue of this, just open to substantial doubt. Any number of ‘correct’ theories may still be unjustifiably underdetermined.

Adbuction

Abduction (also sometimes referred to as Bayesian inference) is an approach to evidence and data developed by pragmatists in the early 20th century (Douven 2011). An adbuctive approach to research regards small or isolated units of data on a larger or very complex subject as typically insufficient to develop theories from without considerable triangulation, because the data otherwise leaves too much of a theory open to question and alternate models. Early pragmatists Charles Sanders-Pierce and William James argued that abduction represented a new and different approach to knowledge production, but it is effectively nothing more than a foregrounding of the hypothetical nature of much evidence and reasoning (Douven 2011). An adbuctive approach then foregrounds an awareness that the individual elements of evidence gathered are insufficient to make a theory which is not unjustifiably underdetermined. These must then be triangulated or further tested with other evidence until enough is present to make a compelling theory. As with underdetermination, this is dependent on what degree of evidence is considered acceptable or necessary in a given situation. In an academic setting it is typical to consider the bar quite high.

A final note on use of terms, throughout this thesis the terms discipline and field will be contested notions, and the nature of each will be dissected and remade. An early attempt to use a different generic term to refer to academic groupings (structure) proved to be more distracting than any aid it provided to precision of terminology. I will therefore, be using

'field' and 'discipline' in the colloquial sense for readability, but will specify when and where a more technical meaning is preferred.

Thesis Structure

Psychology of Interdisciplinarity

Research on disciplinarity and interdisciplinarity has been almost exclusively sociological/anthropological in nature for several decades (with a few notable exceptions). Although many practical and effective insights have come from this approach, the continued lack of consensus on the nature of, or curriculum approaches for, interdisciplinarity suggest that something external may be missing. What is not addressed in the sociocultural analyses is whether there are empirical limits or constraints of *individual* human capacity which may help bound our understanding of interdisciplinarity, or whether there may be non-sociocultural sources which may help determine what the *best* model of interdisciplinary curriculum is. "The world that the student then enters is not, however, fixed once and for all by the nature of the environment, on the one hand, and of science, on the other. Rather it is determined *jointly* by the environment and the particular normal-scientific tradition that the student has been trained to pursue" (Kuhn 1996: 111–12). This does not seem to suggest total social construction, but rather a partial social construction, with social factors as one element and environmental constraints as the other.

The type of evidence needed is within the realm of psychology, and there are in fact several well-developed specialisations of psychology which directly relate to the questions of interdisciplinarity: the psychology of expertise, knowledge transfer, collaboration and distributed cognition, and categorisation. But although there is a well-developed and thriving specialisation within Educational Studies devoted to educational psychology, none of these other fields have been substantially applied to the studies of disciplinarity or interdisciplinarity.

It is important to note that by taking an empirical psychological approach to interdisciplinarity, I am not refuting the value and findings of sociocultural research itself, except where any psychological evidence may do so directly. My view is that Sociology and Psychology (also History and Anthropology) cannot be excluded from each other if a comprehensive understanding of any human endeavour is the goal. My research therefore is complementary to much of the existing research, providing a foundation/framework on which some compelling but less grounded sociocultural notions can rest, as well as to lay

to rest more permanently some notions which appear to disregard strong psychological evidence against them. More detail on this approach will be covered in chapter 4 on research of disciplinarity.

Applied Theory & Medieval Studies

The primary focus of this thesis is on developing a theory of interdisciplinarity which can be related directly to undergraduate curricula in a reliable and consistent way. I am aware that theory, and even empirical studies, can often end up quite far removed from the community/practice which they are meant to address (a common complaint in education reform/theory). To help close this gap I have interviewed seventeen lecturers and researchers from my former 'home' field of Medieval Studies, along with reviewing the literature in the field.

My purpose with the interviews has not been to develop a new model of interdisciplinarity directly from the perceptions of disciplinary practitioners, as they may not be valid experts on interdisciplinarity. Rather I have approached the use of interviews abductively as one piece of evidence to be triangulated. My interest with the interviews then is in comparing the perception of practitioners to each other to other similar interview datasets, and the evidence from the other empirical fields to look for consistency and inconsistency between them. From this hopefully a better curricular approach to interdisciplinarity will emerge.

Undergraduate Curriculum

Beyond attempting to better *define* interdisciplinarity, this thesis is focused on developing a curriculum toolkit for undergraduate interdisciplinarity. This focus is more directed at generic pedagogic structures and interdisciplinarity in the curriculum than with the specifics of module by module interdisciplinary teaching practice. This does not mean that nothing will be said of specific practices where this is relevant to the bigger picture. The choice to limit consideration to the undergraduate is for three reasons. First, this was the original focus of my proposal based on the notion that there should be more time to develop interdisciplinarity in the undergraduate years. Second, because considerable evidence in the review of the literature on interdisciplinary research suggested that training prior to postgraduate levels would be useful. The last reason is simply the scope of the project, extending the analysis to encompass postgraduate or professional study in sufficient detail was not feasible.

Further, a conclusion which applies to the full spectrum of undergraduate students is the goal. That is, the focus is on teaching *any* student to be interdisciplinary, rather than to selectively cultivate those who show talent or interest of their own accord. The latter has been the focus of several prominent examples of interdisciplinary curricula and programmes (Newell 2006; University of Melbourne 2010). The undergraduate focus also clearly restricts the time-frame. This is a critically important restriction, because it means that models of interdisciplinarity which would require more time to apply than a standard undergraduate career are unacceptable here. This restriction does permit that additional training in a professional or academic setting will take place after the undergraduate period, however, but that is not the focus of this study.

Although I will be considering an approach to interdisciplinarity and and the curriculum which is ideally broadly generic, I will base discussion of specifics around the Scottish higher education system as the example. This means that the interdisciplinarity which can be taught (if it can be taught) within four years must meet a commensurate Scottish Credit and Qualifications Framework (SCQF) level of national standards for the degree achieved (level 10).[2]

Lastly, there are at least two substantial aspects of interdisciplinarity in the curriculum which I will not be addressing, assessment of interdisciplinarity and administration of interdisciplinary staff. Each of these would be essential to a final implementation of a practical curriculum of interdisciplinarity; they are not addressed here solely due to the scope of doing so as each could easily be a thesis unto itself.

Triangulation of Evidence

My approach to this work is a synthesis of many disparate fields, ideas, and evidence types. The current state of understanding and practice of interdisciplinarity strongly suggests that it is looking wider, not more deeply, that is most needed to bring many concepts into better focus.[3] Such an approach clearly means that the level of particulate detail which might be expected in a more narrowly focused thesis will not be found here, nor is it the goal. This is not to suggest that rigour has slackened, but that evidence has been approached from a

[2] See Appendix II
[3] It is perhaps ironic that the study of interdisciplinarity suffers from a critical lack of interdisciplinarity.

different perspective, and that this necessitates a degree of trade off between rigour as depth and rigour as critical breadth and triangulation.[4]

Such an approach is not uncommon in educational research, where many different interests and fields typically converge, as others have noted:

> "This mix of multiple data sources, to improve external validity of inferences made from evaluation data, is espoused by many writers (e.g. Kreber and Brook, 2001; Hanbury *et al.*, 2008; Smith, 2008; Bamber *et al.*, 2012). It is particularly pertinent in the case of educational development, where self-reporting could be open to accusations of self-interest" (Bamber 2013: 40).

Bamber continues to describe the 'evidence triangle' conjoining three stages of development to a completely formed conclusion:

- **Research:** alignment with theory, journal papers and the grey literature.
- **Evaluation:** outcomes of consultations and evaluative data.
- **Practice Wisdom:** changes to policy, anecdotes and testimonies, changes to practices, and student outcomes (Bamber 2013: 40).

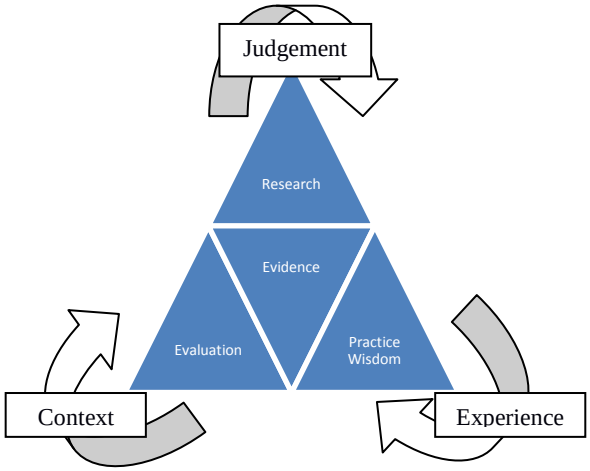

Figure I.1 Triangulation of Evidence (Bamber 2013: 40)

The approach to evidence in this thesis follows this format, but specifically what constitutes each part is slightly different (as it is likely to be in every specific case). The 'research' aspect is straightforward in the form of critical literature reviews of existing theory and research on interdisciplinarity (chapter 1) and disciplinarity (chapter 4). The 'evaluation' section consists of several critical literature reviews/research analysis of heretofore un-reviewed, under-reviewed, or superficially applied specialist subjects in psychology which chapters 1 and 4 indicate a need to engage with. These include a review of the research on the psychology of expertise development, knowledge transfer, and collaborative cognition (chapter 5) and on the psychology of categorisation (chapter 6).

[4] In fact a critical approach to the concept of breadth versus depth forms a substantial theme of this thesis, as it is a key point of contention about interdisciplinary practice.

Finally the ‘practice wisdom’ aspect is supplied by triangulating the existing theory and the empirical research with interviews of practice in the field of Medieval Studies (chapter 7). Such a case study is acknowledged to only supply a small portion of the wider ‘practice wisdom’ that would be desired ultimately, but as we shall see a number of comparable studies have already been done in other fields.[5] The interviews have had the simultaneous goals of testing current theories of interdisciplinarity for coherence with a subset of practice, looking for disciplinary and/or field-based trends in thinking about knowledge, and connecting all of the other research to actual teaching and curriculum practice.

There is a further chapter devoted to the epistemological issues around interdisciplinary theory and academic knowledge (chapter 2) which is also more aligned to the ‘evaluation’ part of the evidence triangle, but which better fits between the literature reviews on interdisciplinarity and disciplinarity to provide context for these. The deep consideration of epistemological questions about the nature of academic knowledge is essential to the consideration of interdisciplinarity, i.e. it is evidence to be analysed. Epistemological differences between the disciplines are frequently cited as hindrance to interdisciplinarity (Snow 1961; Becher 1989; Thompson-Klein 1990, 1996; Repko 2008). It is important then to address the claim of epistemological dissonance directly. I am not convinced that the alleged epistemological differences are as essential or incommensurable as they are often depicted, or if they are, that they need to remain so.

Research Assumptions

I prefer not to regard any knowledge or concepts as ‘self-evident’ in any capacity, for reasons which will be made clear in my discussion of epistemology in chapter 2. However, to avoid the thesis digressing into a purely philosophical discussion, I am compelled to make three assertions, which I perceive to be reasonably uncontroversial within the field of educational research:

1. I presume that the goal of any category, system, model, theory etc. is to approach an optimal balance between usefulness and usability, efficiency and effectiveness, or simplicity and utility. This is a very general concept, and clearly different individuals can have very different, even diametrically opposed, concepts of what achieves this goal. I only take that it is a general and uncontroversial consensus that the goal is not to create more

[5] It is understood that the approach to the practice wisdom aspect of this thesis can only be partial at this stage. Until the conclusions of this thesis are made, there is no new model to apply to practice directly. As such the interviews constitute only the first phase of that aspect of the research triangle.

complexity and/or less utility for their own sake, regardless of whether a model or theory achieves this anyway. This is an important assertion, because it presumes that if the opposite of this goal is indeed achieved we can safely assume it is an unintentional consequence. I do not take this as absolute though; nothing fundamental prevents a person from intentionally violating it.

2. I presume that it is reasonably uncontentious when one is required to work with others that being able to reliably trust in their abilities is a desirable condition, while being uncertain of their abilities is undesirable. This is an important presumption when looking at qualification standards and interdisciplinarity.

3. I presume that a 'correct' or 'effective' solution reached by inconsistent, inaccurate or unreliable means can be *more* problematic than simply an incorrect solution.[6] In the former case this can, and often does, appear to validate the poor methods and reasoning used to find the solution, which can quite easily progress to uncritical use of the same for other applications where the results may not be as effective or could even be detrimental or harmful. A good action reached by bad reasoning justifies bad reasoning.

[6] In this assertion I differ from some mainstream applications of pragmatic epistemology. For more on this see chapter 2.

Chapter 1: Literature Review - Interdisciplinarity

Introduction

A review of the literature on interdisciplinarity is a perhaps Sisyphean effort. In addition to a vast and far ranging literature on interdisciplinarity specifically, there is an even wider and more diverse literature on interdisciplinarity within particular disciplines, as well as considerable literature about effectively the same concepts without using the term interdisciplinary. Further, there is literature on the other 'x-disciplinarity' classifications: multidisciplinarity, cross-disciplinarity, transdisciplinarity, pluridisciplinarity. Fortunately for a review of interdisciplinarity research, these seldom appear in the literature except alongside interdisciplinarity, with the exception of some accounts of transdisciplinarity. Time, space and coherency of focus have required me to be selective with my sources, though I have endeavoured to do so with a critical mind to both the depth and breadth of what the literature has to offer. I have also endeavoured to avoid any 'straw-man' accounts of interdisciplinarity. By this I mean I have not focused my attention on arguments or studies which are clearly weak and easily picked apart, are not well known, or are excessively old and obsolete. I will, however, not avoid arguments or studies which I consider weak and/or obsolete, but which remain popular or influential.

In the sections below I will review the development of the idea of interdisciplinarity as a theoretical concept and a practical endeavour. It is important to note that this is different from a history of interdisciplinary practice. My focus is on the *nature* of interdisciplinarity, including the history of research done to define/describe what interdisciplinarity is. A history of interdisciplinary practice assumes that a definition is already established, or seeks to develop this definition from self-identified historical practice itself. There is, however, no agreed term to refer specifically to the type of study I am doing. 'Interdisciplinary research' or 'interdisciplinary studies' are too ambiguous, as each already refers to specific interdisciplinary practices. I believe that adding '-ity' to either term ('interdisciplinarity research') would still lead to confusion. I will refer then to the study of the nature of interdisciplinarity, how it works and how to do it, to include the history of other efforts to this end, as Research of Interdisciplinarity (RoI).

The RoI literature can be seen as historically and thematically divided into various 'naturally occurring' camps or research traditions of similar interests, backgrounds, geographies and/or epistemologies. Each of these comes to the questions of

interdisciplinarity with a different core purpose and different prior knowledge and assumptions about it. The traditions of RoI that I differentiate are:

- **Historio-Theoretical Research of Interdisciplinarity** (HTRoI) which is chiefly focused on the question of 'what is interdisciplinarity',
- **Scholarship of Interdisciplinary Teaching and Learning** (SoITL), which is concerned with the processes, methods and outcomes of specific cases of interdisciplinary teaching and learning,
- **Research of Interdisciplinary Research** (RoIR), which is concerned with the processes, methods and outcomes of interdisciplinary research,
- **Educational Research of Interdisciplinarity** (ERoI), which is concerned with how interdisciplinarity fits within the curriculum and the wider learning and teaching discussion.

The first three traditions arose concurrently for the most part since 1972, though with only limited exchange between them. In 1972 a large-scale report on interdisciplinarity across several nations, *Interdisciplinarity: problems of teaching and learning in universities*, was published by OECD/CERI (1972). There was certainly interdisciplinarity and discussion of interdisciplinarity before this, but this publication stands out as a landmark which has since been viewed as an 'origin' of research of interdisciplinarity by most subsequent researchers, and after which there was a substantial difference in the amount and focus of RoI (Thompson-Klein 1990; Lattuca 2001; Chettiparamb 2007). ERoI, as a recognisable community of inquiry, has developed more recently, since approximately 2007.

This functional division of research approaches has been a major factor in the lack of clear consensus on interdisciplinarity. For example, most of the work in the first three traditions has not been done by educationalists, but rather by humanities scholars or practitioners in the disciplines themselves. This has led to a substantial lack of engagement between most RoI and the wider field of educational research until very recently. This lack of consensus has been further helped by the historical condition that many of the core theoretical studies on interdisciplinarity have come from post-structural humanities-centric starting points.[7] In a very general sense these have called into question notions of structure, hegemony, reliability, consensus or unity in academic work, which has made the emergence of focused community of study or a coordinated definition appear undesirable or difficult to

[7] This is a substantial contrast to how the question of disciplinarity has been approached, as we will see in chapter 4.

justify. Although the other traditions of RoI have not had these same ontological and epistemological origins, they have also been relatively a-theoretical and have often adopted from this existing HTRoI theory base as it stands. Some recent research has blurred the lines between HTRoI and ERoI by focusing on the broader curriculum in terms of what interdisciplinarity is. This thesis falls into that bracket as well.

Notably, my categories are contingent and pragmatic - not essential, conclusive or exclusive. I make no claims to the certainty or any incommensurability of them. They serve instrumentally to allow certain similarities and differences to be focused on, while self-consciously occluding other traits or possible connections in order to do this.[8] Simply because a particular theory or approach to interdisciplinarity is presented here in one category does not at all mean there are not properties of it that fit in others. There has also been increasing overlap between all of the traditions since the appearance of ERoI, and it is conceivable that this tradition may unify or overtake the others. Several of the most compelling recent analyses of interdisciplinarity have in fact been very difficult to classify into the categories above. Whether this represents the beginning of the end of a Kuhnian paradigm revolution, or merely a poor choice of categories by myself, remains to be seen, but I suspect this is a positive change either way.

These categories were also originally meant as heuristic working categories for my own use, but I have retained them because after dividing by these criteria, other significant patterns emerged, such as that the HTRoI literature almost universally does not engage with the literature on learning and teaching or disciplinarity, or that RoIR, SoITL and ERoI does not engage significantly with the nature of interdisciplinarity *independently*, relying instead on the received wisdom of the HTRoI tradition. The categories themselves did not suggest that there would be so little overlap in this regard. In fact I had originally expected there to be quite a lot. Another way to describe this pattern might be a split between theory and application, and the observation that has driven my work is that there appears to be an unhealthy disconnect between the two, especially in terms of evidence.

Although there has recently been some growing recognition of this state of affairs, what has not occurred is a direct engagement with several problematic aspects of the received wisdom from the HTRoI literature. This has, I believe, allowed this problematic wisdom to continue being received in some quarters even while new empirical work is being

[8] For more on this see chapter 6 on categorisation research.

conducted elsewhere. There remain many examples of uncritical acceptance of the chief metaphors and themes of the HTRoI work done in the 1990s and 2000s, particularly as a base for curriculum and policy reform, as well as in discussion of interdisciplinarity within the disciplines themselves. Because I believe there are fundamental problems with much of this received wisdom which appear to be limiting or occluding both the quality and uptake of newer research (especially in terms of practical curriculum models), I will spend a considerable part of this chapter attempting to draw these out before presenting the approaches and findings of the other traditions.

HTRoI (Historio-Theoretical Research of Interdisciplinarity)

Historio-theoretical research of interdisciplinarity is defined by a primary focus on the core question of what interdisciplinarity *is*. Some accounts move on from this into suggesting curricula or pedagogies, especially in the past few years where the effects of ERoI literature appear to be shifting the focus of the field more generally. The term historio-theoretical refers to a general reliance on historical, rationalist and rhetorical forms of evidence to develop models of interdisciplinarity from, typically to the exclusion of more empirical forms of evidence. Until recently the HTRoI literature has exhibited something of a hegemony over the other traditions. This is not because it was first chronologically, but, it seems, because it was the first to cohere as a focused effort of practitioners. Early RoIR and SoITL efforts were typically scattered throughout the disciplines or in the case of the former in government research reviews, without substantial efforts to relate ideas between them or to develop a theoretical framework that combined the findings of the disparate studies. In fact, HTRoI appears to have developed as this very effort, first intermittently in the 1980s, and then much more coherently and in greater volume from the 1990s onward.

An early focal point of the emerging community was the Association of Integrative Studies (AIS), founded in 1979 by William Newell.[9] The AIS was specifically focused on a type of interdisciplinarity called Interdisciplinary Studies (IDS), which I will discuss more below. The journal of the AIS, *Issues in Integrative Studies*, though small, was for many years the only coordinated source of studies on the nature of interdisciplinarity in higher education. Over 35 years of publication, the journal has remained substantially dominated by scholars from the humanities, and forms a strong backbone of the HTRoI tradition, though there is a

[9] Recently re-branded the Association for Interdisciplinary Studies.

great deal of publication in the tradition outside of the AIS as well, largely in the form of monographs.

A critical review of the HTRoI literature reveals many concerns and many compelling insights, but what I will focus on here is what I believe to be the three largest problems with our understanding interdisciplinarity originating from HTRoI, which continue to hinder efforts to develop a practical interdisciplinary approach to the undergraduate (or postgraduate) curriculum:

- Pluralism
- Disciplinary essentialism
- Competency interdisciplinarity

The specific manifestations of these problems take on a few regular forms in the literature, some explicit and some implicit. The notion of pluralism in interdisciplinarity suggests that there are in fact many interdisciplinarities, all equally or near equally valid. This can be traced back to a chapter by Heinz Heckhuasen in the 1972 OECD report, which still receives considerable citations today, and to several other pluralistic models of interdisciplinarity since, but the strongest sustained influence in this regard is Julie Thompson-Klein (Heckhausen 1972; Thompson-Klein 1990, 1996, 2010b, 2010a). Disciplinary essentialism, the notion that the disciplines are in some way fixed points/cultures around which interdisciplinarity exists, is more subtle and implicit in the literature. It is implicit to such an extent than in many accounts the notion is openly refuted (Thompson-Klein 1996: 46–52; Newell 1992; Repko 2008; Moran 2010). However, in the practice of developing and justifying theories of interdisciplinarity, disciplinary essentialism seems to silently reappear in order to validate many claims. The last problem that I will consider is something which has been referred to positively in some of the literature as ‘minimal understanding’ or ‘adequacy’ (Repko 2008: 189). This is the notion that mastery or expertise is not necessary in order to do good interdisciplinary work, and that a breadth *instead* of depth approach is justified. This has been the target of much controversy over the years around questions of rigour and reliability. The obvious questions here become: what is expertise and how can we know how much is enough; what is ‘good’ interdisciplinarity and how can we know it; is this approach justified for *any* application or only some, and how do we know? These are questions which the HTRoI literature has almost universally not addressed, though recently a few attempts have been

made (Repko 2008, 2012). Before I consider these in detail, I will briefly look at several issues of evidential validity and reliability, which the HTRoI literature consistently struggles with in a broader sense.

Evidential Issues of HTRoI

I refer to this tradition as historical in addition to theoretical because there is a considerable focus on historically based development of definitions of interdisciplinarity, an approach which I suggest derives from three sources: the prevalence of self-identified claims to interdisciplinarity in early RoIR and SoITL which could be drawn on as 'evidence', the strong centre of this tradition in the humanities and therefore with historical thinking, and, itself deriving from the first two, the legacy of Julie Thompson-Klein's highly influential 1990 historical development of the nature of interdisciplinarity, *Interdisciplinarity: History, Theory, & Practice*. An historical approach used in this manner though, is both circular and underdetermined. In the former sense the interdisciplinarity of the examples is pre-assumed, and therefore so is a pre-existing tacit definition of interdisciplinarity, but these are then used to define interdisciplinarity. In the latter sense, most of the examples can be explained in ways other than interdisciplinarity, often simpler ways, and no clear reason is offered why the explanation given is preferred (Peters 1999; Spivak 2003; Thompson-Klein 1990, 2010b; Moran 2010; Brack *et al.* 2010). As noted in the introduction, one of my chief points of departure from previous work is to ask, 'what if none (or very few) of the historical cases of interdisciplinarity frequently used in the literature to define interdisciplinarity actually are so?'

Reliability is a concern for much of the literature in this tradition in other ways as well. It is problematic in the sense that what is claimed is often not actually what the evidence offered indicates or is capable of indicating, such as reliance on interviews with disciplinary practitioners without a clear indication that they possess adequate knowledge of interdisciplinarity.[10] It is only clear, for example, that a historian or a physicist has expertise in their own discipline and knowledge of their own experience of what they *perceive* as interdisciplinarity. It is not clear that either has expertise in defining interdisciplinarity in a general sense or that their experience is generalizable.

Elsbeth Spelt *et al.* (2009: 370) noted that surveys and interviews were among the main methods used by the few empirical studies of interdisciplinary curriculum or pedagogy.

[10] Notably this is a problem which has carried on into the ERoI literature

While this surely produces good knowledge of some kind, and indeed my own interviews have covered much of the same ground, it is not a sufficient method independently to establish a definition of interdisciplinarity. The more this is actually attempted the more different and contradictory answers we seem to get, although there are certainly some patterns if the data is viewed more from an abstracted distance. This lack of singular focus has been taken as evidence of a plurality of valid definitions; I think rather that this is evidence that this is not reliable evidence (on its own). What these results are actually showing, repeatedly and across many disciplines, is strong empirical evidence that the various theoretical models of interdisciplinarity offered over the past several decades have failed to achieve any coherency on the ground (Lattuca 2001; Nikitina 2002; Lattuca *et al.* 2004; Moran 2010). As we shall see in chapter 7, this is especially true if we ask the same academics to define both disciplinarity and interdisciplinarity separately, something that has not appeared in the literature thus far, but which was a key component of my interviews with 'interdisciplinary' medievalists.

The existence of this problem was noted by Marcel Boisot in the 1972 OECD report, and was given as the reason there was no agreed definition for interdisciplinarity at that point, "Each definition put forward by scientists seems to result from an analysis of individual experiences which involve mechanisms and procedures that are too restrictive for general application" (Boisot 1972: 90). It is clear from citations that most HTRoI researchers are familiar with the wider OECD 1972 source, but Boisot's warning has not been repeated.

A further trend in much HTRoI research is a tendency to overstate what the evidence shows, especially in terms of the benefits or value of interdisciplinarity. There is a consistent claim of 'betterness' for interdisciplinarity as a solution to climate change, broad social issues or major scientific problems under the presumption that these issues are too big for a single disciplinary approach (Thompson-Klein 1990, 1996, 2010a; Newell 2001, 2010; Meek 2001; Repko 2012). But evidence of the actual impact of interdisciplinary projects, especially compared to non-interdisciplinary projects is absent. This should be essential if a claim to being 'better' is being made. Some have suggested that interdisciplinary research can be evaluated by looking at the quality, novelty and degree of integration, but this clearly only assesses the act of being interdisciplinary, not the actual work produced (Newell 2006; Huutoniemi 2010: 313). At least one attempt has been made to directly answer this question, however, the results were far from conclusive (Lattuca *et al.* 2004). Given only the HTRoI literature, it would be impossible to argue from an evidential base that interdisciplinarity was preferable to the alternatives; alternatives which

are often less expensive and time-consuming as well. I do not believe this is true, but one could not demonstrate this from the literature in this tradition alone.

The summation of these issues suggests a general problem of underdetermination for the majority of the theories and models within this tradition. Many theories presented in the HTRoI literature could indeed be correct or useful, in whole or in parts, but the evidence supplied is typically unreliable to such a degree that we simply cannot justify accepting them. I will now look in more detail at three of the most persistently problematic approaches to interdisciplinarity found in the HTRoI literature which continue to pervade policy and practice.

Pluralism

The principle of pluralism is that interdisciplinarity is not one but many distinct categories of different activities/things related to an underlying core or umbrella concept of interdisciplinarity. Arguably the progenitor of most pluralistic approaches to interdisciplinarity was Heinz Heckhausen in 1972. There are though, a number of issues with the generalizability of Heckhausen's report. Heckhausen defined 'the disciplines' as only the sciences, excluding any 'pure' disciplines, even Maths. Psychology occupied a strange position of being a discipline but not being able to be referred to like the others. He also referred to interdisciplinarity as a 'fad' (Heckhausen 1972: 83). His model of interdisciplinarity was built on top of his model of seven 'epistemological' criteria which make up a discipline. These criteria were based on positivistic concepts of disciplinary knowledge and subject matter, a notion which was already falling out of favour then and has far more so since, especially in the postmodern-centric HTRoI literature. Based on these Heckhausen developed six types of interdisciplinarity, several of which were not actually interdisciplinarity at all according to Heckhausen.

Indiscriminate	Superficial and over-generalised 'encyclopaedic' combinations of disciplines (not actual interdisciplinarity)
Pseudo-	Sharing of analytic tools (not actual interdisciplinarity)
Auxillary	Borrowing of methods between disciplines
Composite	Problem-based large scale endeavours such as city planning in a broad sense
Supplementary	On-going partial overlaps of close disciplines
Unifying	Creation of new hybrid disciplines

Figure 1.1 Types of Interdisciplinarity (Heckhausen 1972: 86-89)

Regardless of the abandonment in the HTRoI literature of his model of disciplinarity on which it was built, Heckhausen's model of interdisciplinarity continues to reappear as a basic foundation of it some of the most influential HTRoI literature (Thompson-Klein 1990; Chettiparamb 2007; Davies and Devlin 2010).

Since Heckhausen there has been proliferation of 'interdisciplinarities', with dozens of separate authors each suggesting a different taxonomy of as little as two to potentially more than 100 classifications and sub-classifications of interdisciplinary interactions, activities and motivations (Thompson-Klein 1996; 2010b; Lattuca 2001; Nikitina 2002; Aram 2004; Huutoniemi 2012). A literature review of RoI in 2007 presented at least 59 different categories from multiple authors, and was still not as comprehensive as it could have been (Chettiparamb 2007). Another recent pluralistic project has attempted to provide a stronger empirical rationale for a specific taxonomy, and also attempted to reduce the overall complexity by correlating the categories with some earlier taxonomies (Huutoniemi *et al.* 2010). This, however, still has 42 possible combinations of three aspects and several sub-aspects of interdisciplinarity.

The chart below was offered by Huutoniemi *et al.* (2010: 81) to list just some of the taxonomies. The apparent simplicity is misleading in some cases, as there are often sub-classifications, correspondent relationships or conditions not listed here:

Focus of interest	Author(s)	What produces categories?	Categories
Degrees of disciplinary integration			
	OECD (1972)	Development of scientific knowledge	Multidisciplinarity, pluridisciplinarity, interdisciplinarity, transdisciplinarity
	Heckhausen (1972)	Maturation of interdisciplines	Indiscriminate ID, pseudo-ID, auxiliary ID, composite ID, supplementary ID, unified ID
	Miller (1982)	Degree of conceptual order	Topical focus, professional preparation, life experience perspective, shared components, cross-cutting organizing principles, hybrids, grand synthesis
	Stember (1991)	Responses to dissatisfaction with Disciplines	Intradisciplinarity, cross-disciplinarity, multidisciplinarity, interdisciplinarity, transdisciplinarity
	Boden (1999)	Strength of ID	Encyclopedic ID, contextualizing ID, shared ID,co-operative ID, generalizing ID, integrative ID
	Karlqvist (1999)	Distance between fields	Unification of knowledge, accumulation of knowledge, doing different things, doing things differently, thinking differently Interdisciplinary practices
	Rossini and Porter (1979)	Socio-cognitive frameworks for integration	Common group learning, modeling, negotiation among experts, integration by leader
	Lenoir *et al.* (2000)	Social representations of ID	Eclectism, pseudo-ID, hegemony, holism
	Lattuca (2001)	Research questions	Informed disciplinarity, synthetic ID, transdisciplinarity, conceptual ID
	Palmer (2001)	Cognitive strategies for ID	Team leader, collaborator, generalist
	Bruun *et al.* (2005b)	Knowledge networking	Coordination, translation, pioneering
	Bruun *et al.* (2005a)	Interactions between fields	Encyclopedic MD, contextualizing MD, Composite MD, empirical ID, methodological ID, theoretical ID
	Lengwiler (2006)	Organizational practices	Methodological ID, charismatic ID, heuristic ID, pragmatic ID
	Pohl *et al.* (2008)	Forms of collaboration +means of integration	(Two-dimensional matrix of the possible combinations of the latter)
Rationales of Interdisciplinarity			
	OECD (1982)	Demands for ID	Endogenous ID, exogenous ID
	Thompson-Klein (1985), Salter and Hearn (1996)	Motives for ID	Instrumental ID, conceptual ID
	Bruun *et al.* (2005a)	Type of research goals	Epistemological ID, instrumental ID, mixed goals
	Boix Mansilla (2006)	Epistemological approaches to ID	Conceptual-bridging, comprehensive, pragmatic
	Barry *et al.* (2008)	Logics that guide ID	Accountability, innovation, ontological change

Figure 1.2 Pluralistic Interdisciplinarity Models

Ultimately, it is not feasible to attempt to 'disprove' any pluralistic account of interdisciplinarity. This would require individually assessing each category of each model. Further, it is perfectly likely that there are compelling arguments in favour of some, even many individual classifications when considered in isolation. My position at this stage is not to suggest that interdisciplinarity cannot be pluralistic (though I do not think it is best described this way). Rather I would raise the question of the utility or benefit such systems can have when there are so many continuously being produced over such a long time, and with little correlation or evidential base among them. The purpose of such models is surely to develop a deeper and more nuanced understanding of the many ways in which interdisciplinarity appears to manifest in real practice, but the result of this effort seems to defy the basic tenets of definitional or classificatory systems: to reduce complexity and/or increase utility. Chettibaramb (2007: 19) has suggested that, "These classifications lend

conceptual clarity to the notion [of interdisciplinarity]", but how this is achieved, especially at the level of curriculum design, is uncertain and I would suggest highly questionable. The pluralistic models of interdisciplinarity as they stand are highly underdetermined, and do not offer any means to determine which, if any, model is more effective, whether some are compatible and some are not, or more importantly what basis in empirical evidence or practical application for learning and teaching they have. Further, they are descriptive in nature, and therefore do not offer a means to develop new interdisciplinarities, only to classify after the fact.

Some have suggested that pluralism in interdisciplinarity is unavoidable:

> "Multiple 'interdisciplinarities' exist, as Thompson-Klein (Thompson-Klein, 1996, p.153) portrays, "from simple borrowings and methodological thickening to theoretical enrichment, converging sites, and a general shift . . . to new 'cross-', 'counter-', and 'antidisciplinary' positions that front the problem of how meaning is produced, maintained, and deconstructed". Interdisciplinarity is thus best understood not as one thing but as a variety of different ways of bridging and confronting the prevailing disciplinary approaches" (Huutoniemi *et al.* 2010: 80).

Instead, I question whether these widely varied manifestations of interdisciplinarity genuinely represent the same overall practice, or if in fact a range of quite dissimilar activities are being ineffectively categorised together, producing an inability to find a cohesive definition for interdisciplinarity that would encompass them. Equally possible is that it is correct to see these activities all as interdisciplinarity, but that the perspective on interdisciplinarity being applied does not adequately address the commonalities that make each practice so. My hypothesis is that an answer to these questions lies (in part) in more deeply considering the nature of human categorisation itself, to see if empirical research in that field can illuminate questions about optimal categories, types of categorisation, and what best constitutes a category (i.e. are some categories empirically better than others?) (chapter 6).

Although pluralism is something of a norm in the HTRoI literature, it is not without its opponents. William Newell, long time collaborator with Thompson-Klein, takes a very different approach, and also suggests that there is debate on the matter:

> "These epistemological issues have led to vigorous debates within AIS [Association for Interdisciplinary Studies] itself. There has always been a vocal faction of members who caution against definitional closure for interdisciplinarity on the grounds that settling on any definition excludes as

> well as includes; they prefer to let a thousand flowers bloom. Arrayed on the other side of the debate have been members seeking credibility for interdisciplinary study through conceptual clarity and, ultimately, through standards for judging its quality" (Newell 2001: 6).

I would align myself then with the second camp, and ask what use it is to let a thousand flowers bloom if they are obscured among one hundred thousand weeds?

Disciplinary Essentialism

Essentialism refers to the idea that there is a foundational and reasonably unchanging reality to the disciplines themselves, either a socially constructed fundamental reality, or an ontologically grounded one (in terms of subject matter). It is not typically a very clearly defined concept, and in fact the term itself is seldom used. As I use it here, it refers to the notion that disciplines, often only certain ones, simply are and always will be, that they are either natural categories which will always reassert themselves, or they are such stable social realities that they will not be undone without great effort. The unspoken assumption then is that whatever is not one of these must be interdisciplinary. Indeed, this is how many historical definitions of interdisciplinarity have identified interdisciplinary examples (Thompson-Klein 1990; 2000, 2008; Repko 2008; Welch IV 2009, 2011). The notions of ownership and interdisciplinary identity are also intrinsically linked to disciplinary essentialism in much of the literature, though not often explicitly so.

The presence of the notion of disciplinary essentialism in the HTRoI literature is difficult to show unequivocally. It is typically implicit in the logical necessities of models and metaphors of interdisciplinarity, such that these could only work if the disciplines were viewed as static, while the same notion is openly refuted in order to develop other aspects of the same theory or to correspond with evidence (Thompson-Klein 1996: 38, 2010b). Often the nature of the disciplines themselves are not extensively explored, the definitions resting on tacit presumptions or rationalised models with limited recourse to empirical evaluation and which focus on perceived limitations (McArthur 2010: 303). There has also been no significant engagement with existing research on disciplinarity.[11]

[11] The only two sources of discussion of the nature of the disciplines, which are not focused first on interdisciplinarity, that were cited in any of the sources I reviewed were Anthony Becher's landmark ethnography of the disciplines *Academic Tribes and Territories: intellectual inquiry and the cultures of the disciplines* (1989), and Ellen Messer-Davidow, *et al.*s' *Disciplinary Ways of Knowing* (1993). The former is only cited briefly in a very few HTRoI sources, while the latter neither cites nor is cited by any other sources on disciplinarity that I am aware of (in fact it denies that such exist). Notably, both accounts are strongly social-constructivist in nature.

Even in accounts which promote the idea that interdisciplinarity creates new disciplines, this tacit dividing line seems to underlie the discussion (Moran 2010; MacKinnon, Hine, and Barnard 2013). One notable early view to the contrary was that of Jean Piaget in the OECD 1972 report. Piaget here suggested that all disciplines have always been interdisciplinary, and always will be, and that none have arisen except through fragmentation or combination of other structures before them (Piaget 1972: 136). Piaget's account has received no significant attention since, however, similar notions have appeared independently from time to time (Rowland 2006: 96; Weingart 2010: 12).

Disciplinary ownership in the HTRoI literature is closely related to essentialism. The popular metaphor of interdisciplinarity as an act of borrowing, usually of concepts, methods, perspectives, or technology, is the best example of this (Thompson-Klein 1990, 1996; Bromme 2000; Davies and Devlin 2010). Earlier accounts, especially those centred around the sciences in the 1972 OECD report, were unambiguous about disciplinary ownership. Boisot describes this as when, "a crude phenomenon *belonging* to one discipline…is legalised by a law…belonging to [discipline 1], we shall say that there is *linear interdisciplinarity* in the sense that law [x] is *borrowed* and adapted by [discipline 2]…" (Boisot 1972: 92). More often the role of ownership is implicit in that in order for theories, methods, laws or other aspects of a discipline to be borrowed by 'interdisciplinary' activities, the disciplines must be perceived as entities which have the capacity to be borrowed from.

Although borrowing appears to be a common sense metaphor for interdisciplinary activities, if what the metaphor requires or implies is examined more closely it becomes clear that it is fraught with internal contradictions:[12]

- Borrowing tacitly assumes that the disciplines have both the right and ability to claim ownership of various methods, concepts, tools, techniques and perspectives, though there is no recognised authority to adjudicate this, or consensus on the matter.
- Borrowing presumes the return (or intention to return) of the borrowed element in the condition it was given, but this contradicts the transformative or integrative core typically assigned to interdisciplinarity.
- Borrowing presumes that permission has been or can be given, but there is no structure to either ask for or give such permission in the disciplinary system.

[12] As the utility of a metaphor is to relate a complex situation to a more understandable one, I assume here that 'borrowing' is to be read in a 'common usage' manner.

Notably, the borrowing metaphor does not appear to have the strong currency it once had, though it is far from gone in the more recent literature.

Both essentialism and ownership in most accounts are regarded as strongly situated social constructions, not deterministic truths. But when these concepts are applied to develop models of interdisciplinarity, the distinction between social construction and determinism becomes less clear. This creates the paradox wherein many HTRoI models of interdisciplinarity rely on the explicit discussion of the breakdown of disciplinary cores and ownership either as facilitating or necessitating interdisciplinarity, while also relying on the implicit stability of these same notions as a feature of how interdisciplinarity functions in practice. In at least one case, Thompson-Klein appears to tangentially undermine the notion of disciplinary ownership by stating that disciplinarians cannot be presumed as homogenous, "Generalizing about how "the lawyer" or "the anthropologist" would behave in a collaborative situation is dangerous in this or any other case, since there is no single model of either disciplinarian" (Thompson-Klein 1990: 185). It is conceivable, even likely, that both features are active concurrently within the same disciplines: the progressive and the traditional in concert. If so, then it would clearly serve the understanding of interdisciplinarity better to examine this dichotomy in detail, and from as many empirical sources of evidence as possible, but this has not has been done so far.

The presence of disciplinary essentialism has another face in the HTRoI literature, as the 'other' that defines 'us'. "Interdisciplinary activities are located across an expanse of physical and social situations. Because disciplinarity has been the dominant system over the course of the twentieth century, *they* have had to establish an *identity* and place…" (Thompson-Klein 1996: 19). The HTRoI tradition has a strong base in the humanities scholarship of the 1980s and 90s, and this includes emancipatory perceptions of interdisciplinarity as an escape from a positivistic, often neo-liberal, disciplinary regime which supresses the 'better' and more 'real-world' solutions to larger social problems that interdisciplinarity can allegedly provide (Thompson-Klein and Doty 1994; 2012; Mackey 2001; Bailis 2001; Spivak 2003; Repko 2006b; Ellis 2009; Moran 2010; Beilin and Bender 2010; Bhaskar 2010). In some accounts the disciplines are seen as the direct agents of this suppression, either passively through blind tradition or actively through a desire to control knowledge production (Messer-Davidow *et al.* 1993; Keller, E. 1993; Lenoir 1993; Amariglio *et al.* 1993; Bernstein 2000). In other accounts both the disciplines and interdisciplinarity are victims of consumerist or neo-liberal controls from university

administrations, funding councils, professional investors or governments (Bernstein 2000; Wheelahan 2012).

In order to develop a sense of emancipatory identity for interdisciplinary scholarship, it is created as a 'thing' which is different from the disciplines; it becomes an academic identity unto itself, defined as 'not disciplinary'. For this to happen the disciplines, or at least the administrations and funding bodies, need to be seen as able to assert definition and ownership to the things that are being withheld, those things which interdisciplinarity is not. This line of reasoning is consistent across much of the HTRoI literature to greater or lesser degrees, but nowhere is it more clear than in Thompson-Klein's *Creating Interdisciplinary Campus Cultures*, wherein it is suggested that interdisciplinary scholars must protect their status by developing institutes and centres which are constantly vigilant against being absorbed into the disciplines or dissolved by administrations (Thompson-Klein 2010b: chapter four).

Others, however, have noted that interdisciplinarity proceeds regardless of apparent administrative and disciplinary blockages, and that many disciplinary practitioners have suggested that there was not much of a problem (Lattuca 2001). "Moore (2011) proceeds to argue that interdisciplinarity actually works (and, generally, *always has* worked) 'on the ground' with the disciplines in a manner that is stable, productive, and complementary" (Barrett 2012: 100). It would seem premature to say no blockages exist, though. Where such forces may indeed be blocking efforts, we might ask whether these are a check not to allow borrowing or interdisciplinary efforts be too shallow or over-reach themselves, and therefore lose reliability or rigour. That this could be the case, and may indeed be quite necessary or desirable as an integral aspect of interdisciplinarity, is almost never suggested in the HTRoI literature. It was, however, a recurrent theme in the interviews I conducted with 'interdisciplinary' practitioners in Medieval Studies, as well as the stories of other people practicing in that field (chapter 7).

Another manifestation of the need for discrete identity can be seen in the notion of interdisciplinarity as 'greater than the sum of the parts' (Newell 2001; Thompson-Klein 2004; Boix Mansilla 2006; Huutoniemi *et al.* 2010: 83). This suggests that an interdisciplinary action or solution is inherently 'more' than the separate elements which create it, such that it is an irreducible whole which cannot be merely sub-divided into

disciplinary parts.[13] More on this notion will be explored in chapter 2 on epistemology and holism.

Another expression of the notion that interdisciplinarity is a standalone entity is that it does *not* lead to the creation of new disciplines (Fish 1989; Thompson-Klein 1996, 2010b; Moran 2010; Wexler 2012). Thompson-Klein is one of the strongest opponents of the notion of interdisciplinarity leading to new disciplines, "One of the myths about interdisciplinarity is that the 'inter-discipline' of today is the 'discipline' of tomorrow" (Thompson-Klein 2010a: 22).[14] Thompson-Klein offers this as a truism though. The identity-based resistance to classification as a discipline that this promotes is most clear in proliferation of another type of pluralism: the development of an array of classifications such as 'interdisciplines', hybrid disciplines, studies, fields and cross-disciplinary specialisations.

But what actually *are* each of these sub-types, in terms that not only distinguish each from a discipline, but also from specialisms, other interdisciplinary activity, and each other? Definitions are seldom offered; more often these categories are regarded as tacit and 'understood'. If definitions are given, they do not compellingly meet these criteria (Davies and Devlin 2010: 5). Like the pluralism of interdisciplinary activities and motivations discussed above, there seems little to recommend these new categories in terms of promoting clarity or added functionality.

> "The challenge of interdisciplinarity…is one of strategic positioning. All interdisciplinary fields, by extension, need to establish relations to their objects of study, define relations to other disciplines, assert their own boundaries and mission, and questions the self-understanding of disciplines as coherent and unified entities" (Jassanoff 2010 cited in Thompson-Klein 2010b: 160).

It is unclear in this example how this differs from a discipline, and it is often only by asserting an essentialist rigidity to the disciplines that such a distinction is upheld.

I wish to be clear that it is not the development of new areas or topics of study that I am questioning the utility of, only the assignation of these to an array of new non-disciplinary yet discipline-like titles. It has also been noted by Tony Becher that the pressing need to find a research niche in which to publish may be involved in this process as well

[13] This is typically the definition given for multi-disciplinarity, that the irreducibility of integration has not been achieved.

[14] In recent years Thompson-Klein has accepted that interdisciplinary may sometimes lead to new disciplines

(1989: 52–55). If this is the case then creating these new types could be seen as prohibiting interdisciplinarity by developing new levels of isolationism, if it even has anything to do with interdisciplinarity at all.

One recent account which presents a good example of this concept is a discussion of the 'interdisciplinary' field of Biotechnology by Brack *et al.* (2010).[15] The paper discusses the need to develop interdisciplinary skills early in two undergraduate Biotechnology programmes in order to help students engage with the ethics of the field, professional applications, critical thinking, collaboration, peer and self assessment or inquiry-based learning. The status of this as a recommendation is something I will return to in later chapters, but what is of interest here is the authors' approach to the status of Biotechnology itself. Biotechnology is regarded in the article as a clear example of an interdisciplinary field. However, since 1990 there are more than 30 undergraduate programmes in the field in Australia alone. The authors refer to the inquiry-based teaching approaches of these as being offered "within a real Biotechnology framework" (Brack *et al.* 2010: 250). But does it make sense to refer to a 'real framework' for a field which is functioning as a dependant hybrid of other disciplines? A field with so many dedicated undergraduate programmes seems hard pressed to make a case of being subordinate to other disciplines. Further, there is no indication that students learn any *discipline specific* knowledge or skills outwith the Biotechnology courses which are not already integrated strongly into a Biotechnology context.

The rationale for the claim to interdisciplinarity here is that several aspects of the field are also studied in greater detail in the parent disciplines. But if this greater detail is not required for qualified expertise in Biotechnology graduates, then it is unclear how this is germane to Biotechnology as a programme. Certainly a major change in one of the parent fields will have effects on Biotechnology as well, but this is could be argued for most disciplines to greater or lesser degrees: that a significant change in one ripples through many others over time. This would imply that either all disciplines are interdisciplinary (as Piaget and some others have suggested), none of them are, or that there is an arbitrary but specific degree of influence/proximity that indicates one or the other. The implication is typically that the latter is true, but there is no indication of how this is determined or what the criteria may be.

[15] This work is one of a small number of recent accounts of interdisciplinarity which was difficult to categorise. This, along with another chapter by Mackinnon in the same year, is equally representative of HTRoI and ERoI.

Competency Interdisciplinarity

Another prominent approach to interdisciplinarity in the HTRoI literature is what I refer to in a broad sense as ‘competency interdisciplinarity’. Competency interdisciplinarity focuses on a breadth *instead* of depth model, promoting in one way or another that students should learn about many disciplines (usually at least three) which are often only loosely related instead of focusing on expertise in a specific area. Competency models are almost exclusively focused on undergraduate study, and unlike most other HTRoI approaches competency models often have an applied output in the form of a vast array of Interdisciplinary Studies (IDS) programmes and university curriculum restructuring over the past few decades. This makes the fact that such models are typically based on very questionable evidence all the more troubling.

Notably, competency models are far from uncontested, even in the HTRoI literature. At least as many publications in HTRoI, and more in the other RoI traditions, come down hard in favour of disciplinary mastery and expertise prior to interdisciplinarity being at all viable. In RoIR at least, this can be attributed to the strong science-centric base of the tradition, and the typical assumption that interdisciplinarity is a collaborative and postgraduate issue. This opposition has not, however, prevented the competency model from being directly employed as policy in universities through IDS programmes, other ‘interdisciplinary’ degrees or thematic restructuring, or taught as a methodology for interdisciplinary work (University of Uppsala 2013).

IDS, as one type of competency interdisciplinarity, has been and continues to be widely promoted as a viable curriculum option by the AIS.The AIS promotes IDS chiefly in the US, but increasingly worldwide, as a model of undergraduate learning which culminates in the graduate being an ‘interdisciplinarian’, which is considered to be a profession unto itself (Newell 1994, 2010). Another type of competency interdisciplinarity is found in non-disciplinary or thematic university restructuring. There is something of a tradition of this in Australia, though it is not isolated to there. Previous attempts to develop a non-disciplinary university structure include Murdoch University (Marshall 2010). More recently (2008) the University of Melbourne has attracted international attention by restructuring to a thematic, socially focused curriculum model which featured students taking substantial portions of their coursework as mandatory breadth options (Golding 2009; University of Melbourne 2010). The Melbourne model is particularly worthy of attention because it has been an

inspiration for similar restructuring in several other elite universities around the world (e.g. Harvard, Aberdeen, Hong Kong) (Fiksdal 2013).

There are a few consistent features of both IDS and thematic restructuring:

- each promotes the notion that 'being interdisciplinary' is the goal of study;
- each promotes that this goal is more critically and socially conscious and/or employable outside of university;
- examples of each bear little or no resemblance from programme to programme in terms of structure, range of disciplines covered, learning outcomes, or qualifications;
- most in practice cater to very small numbers of especially elite and self-motivated students, not the wider student community;
- each promotes the notion that interdisciplinarity is something to be performed by an individual, and that this can be effectively completed in a standard undergraduate timeframe.

The first two elements are typically the focus of discussion in the literature on IDS and restructuring, relying often on the same 'betterness' rhetoric as many essentialism arguments. The first two elements are also not terribly contentious; in a broad sense they appear to be good goals of education in general. It is the other three elements that present substantial problems for this popular approach to interdisciplinary curricula.

The third element opens difficult questions about the transferability of qualifications and the degree of trust such programmes engender in the skills of graduates. This has been a general criticism of interdisciplinary programmes for many years, that they lack coherency or rigour (Rowland 2006: 95). It has also been a rallying cry of 'us versus them' within the HTRoI literature, involving claims that academic standards are a hindrance to education (Davis 2011; Wexler 2012). But what is lacking is evidence one way or the other (Rowland 2006; Wexler 2012). The lack of a coherent core of structure, range of disciplines or learning outcomes makes generating benchmarks, qualifications and trustworthy standards for graduates inconceivable (and may be why some proponents have sought to attack the concept of standards). It is entirely likely that many such programmes offer excellent teaching, well crafted degree structures and cater to motivated and forward-thinking students. This has no clear value to the outside observer, particularly a potential employer,

though, if there is no way to identify what the graduate has learned from one programme of the same name to the next.

Alternatively, the Melbourne model promoted confident flexibility, collaborative understanding and disciplinary specialisation, but the disciplinary aspect in practice appears to have been swept under the carpet to make room for interdisciplinary options, broad themes of current social issues, and mandated breadth throughout the programme. What resulted was a compellingly researched and presented programme which did not ultimately produce a recognisable qualification, regardless of greater compatibility with international curriculum standards being the stated goal (University of Melbourne 2010). Shortly after implementation the Melbourne model came under criticism (and also praise, to be fair). In response proponents have suggested that postgraduate study should be the new location for disciplinarity, suggesting that specialisation should not be the focus of undergraduate training (Davis 2011).[16] Effectively the argument suggests that qualifications should not be something undergraduate study is designed for, similar to the responses against qualifications by IDS proponents. The importance of such subject qualifications for employability, academic trust and reliability will be explored in more detail in chapter 5.

The elite or isolated status of both IDS programmes and thematic universities is explicit in a number of reports, most of which are intended to demonstrate the broader value of the approach. Proponents of the Melbourne model have responded to falling enrolment since the restructure with the notion that the programme is meant to attract the ‘best and the brightest’(Davis 2011). A similar demographic was found in the IDS Western College programme at Miami University, Ohio, one of the early flagship programmes created by AIS founder William Newell. Students on the interdisciplinarity programme made up only 8% of the 'honours' level students, while only representing the top 1% of the total student body (Newell 2006: 91). This trend has even occurred in the field of Medieval Studies in Scotland, as my interviews highlighted. The University of St Andrews has an undergraduate Medieval Studies programme, but each year only two to three students enrol, and these are noted as self-driven and exceptional within the student body: St Andrews being already an elite research intensive university. Each of these cases suggest that what limited success IDS and thematic restructuring have had are only in terms of a very small

[16] While this may be a compelling argument as part of a larger discussion on tertiary education as generic and mandatory, it is not compelling when the overwhelming majority of graduates do not continue to the Masters level.

percentage of already exceptional students, not a representative sample of the wider university enrolment.

The final unifying factor of competency interdisciplinarity models is that interdisciplinarity is taught from start to finish as something performed by individuals, as a solitary professional act (Newell 1994, 2006; Repko 2008; Szostak 2008; Thompson-Klein 2005b, 2010a; Mackey 2002). The presumption that interdisciplinarity can be credibly approached as a solitary act at the undergraduate level is problematic. I will examine this in more depth in chapter 4 concerning expert teams and transactive memory.

To make room in the curriculum for so much broad study by an individual student, the competency model also leaves little space for engagement with the primary sources of any discipline. In IDS and thematic programmes some limited engagement presumably takes place, though when and to what degree is highly questionable. For example, in the popular process proposed by Alan Repko it is explicit that working with primary sources is not involved at all (Repko 2008: chapter 8). Interdisciplinarity then becomes data mining, and not very proficient data mining at that. There is no recourse to primary data creation, *nor the development of the skill to do so*, and it is the latter aspect which makes the ability to credibly analyse even secondary sources suspect. A more recent middle ground appears to exist in the form of Huutoniemi, *et al.*'s suggestion that, "While mastery of the participating disciplines is not required, it is still acknowledged that interdisciplinary study should build explicitly and directly upon the work of disciplines" (Huutoniemi 2010: 314). But while this seems more reasonable, it, in essence, still says that only recourse to secondary sources is required, and without clear evidence of the mastery to effectively analyse these.

The solitary 'interdisciplinarian' notion is best exemplified by a form of argument for competency interdisciplinarity which continues to enjoy considerable popularity in publication and interdisciplinary curriculum design: the notion of 'adequacy' or 'minimal understanding' as a programme learning objective. This is the *explicit* claim that disciplinary mastery is not necessary for good interdisciplinary work.[17] Allen Repko is perhaps the most widely recognised recent proponent of the competency model;

[17] Such an explicit claim is made in the Melbourne model, though it specifically applies to 1st and 2nd year courses (Golding 2009: 5). Melbourne's dilemma appears to have been not succeeding in achieving disciplinary expertise, as opposed to explicitly refuting it.

consideration of his approach, however, leads back through several justifications by other prominent authors.

Repko states that ‘minimum understanding’ or ‘adequacy’ is sufficient for good interdisciplinary knowledge and research, and that even undergraduates can learn most of what they need to know about using tools and concepts of other disciplines quickly and easily, and without the need for expertise in them. “Once students have identified the disciplines that are the most relevant to the problem, they must develop adequacy in each of these disciplines” (Repko 2008: 192). The notion of ‘adequacy’ is in part justified by the work of William Newell:

> “if the problem can be illuminated adequately using a handful of introductory-level concepts and theories from each discipline, and modest information readily and simply acquired, then a solo interdisciplinary researcher or even a first year undergraduate student can handle it. Luckily, one can get some useful initial understanding of most complex problems using a small number of relatively basic concepts from each discipline” (Newell 2007: 253 cited in Repko 2008: 192).

The problems here are three-fold. The first is simply that Newell does not provide evidence to support this statement. The second is that it promotes unjustified underdetermination as a positive learning objective. It is not actually possible to determine how much disciplinary expertise is or is not required to answer a given problem without already possessing the necessary expertise to make such an evaluation; we cannot assess the value of something we do not understand. While it is true that even experts have this limitation, in that case there is no reasonable recourse but to make an educated guess, making this a matter of *justified* underdetermination. Yet it seems irresponsible in the extreme to be aware that greater expertise is reasonably available, but to judge that this is not needed without possessing the necessary skill to make this evaluation. More important here, however, is that Newell’s original quote began with “But” and was preceded by a section discussing the need for expertise and expert collaboration in cases not identified as this simple *by experts*. Newell was addressing the special case of undergraduate teaching, in which expert instructors are on hand to compensate for the lack of student ability to know what is or is not a simple problem, and he was clear that this analysis only should apply in such cases; Repko’s analysis mentions none of this (Newell 2007: 253). Repko does suggest that the problem can be overcome in a more general sense, only if deemed necessary by the ‘adequate’ researcher first, by consulting disciplinary experts about it. At this point, however, this is no longer a solitary or minimal understanding approach, but is collaboration with experts.

The notion of ‘minimal understanding’ Repko derives from Thompson-Klein (2005 though originally (Thompson-Klein 1990: 53)).

> “Borrowing from another discipline requires assuming what Janice Lauer called the ‘burden of comprehension.’ A minimal understanding of its cognitive map is needed, including basic concepts, modes of inquiry, terms, observational categories, representational techniques, standards of proof, and types of explanation. Learning a discipline in order to practice it, though, is different than using it for an interdisciplinary purpose. Disciplinary mastery connotes complete knowledge, interdisciplinary work requires adequacy” (Thompson-Klein 2005a: 68).

These claims are contrary to considerable evidence on the nature of expert versus competence level knowledge (Chi *et al.* 1988; Ericsson n.d.). Also it is unclear what ‘minimal understanding’ means if it must encompass all of the features listed here, and yet be more simple to master than disciplinary expertise itself. More importantly though, Janice Lauer’s original statement on this matter was quite different:

> “But the field pays a high price for multimodality. As Ranken cautions, anyone who borrows work from another field must not only acquire an accurate and thorough grasp of the work itself, but also must understand its context, history and the status it enjoys in its parent field. Without such accurate understanding, a scholar risks building an elaborate edifice on sand. The burden of thorough comprehension also falls on the rest of the members of the discipline who receive and assess such work. And as multidisciplinary scholarship accumulates and begins achieving the status of received tradition in the field or written discourse, it must be mastered by those entering the field” (Lauer 1984: 26).

All references to ‘thorough’ and ‘accurate’ were subsequently dropped from Thompson-Klein’s paraphrase, as was any indication that the point of the statement was to assert the absolute need for disciplinary levels of expertise in borrowing ideas, as well as the extension of responsibility to the entire borrowing discipline to check the results. What Lauer said and Thompson-Klein’s interpretation could not be more contradictory.

Unlike pluralism or essentialism, this issue also presents substantial potential for harmful effects beyond the academy. The model is specifically engineered to produce maximum decision making confidence at the same time as minimal expertise in the relevant field. The proponents of these models view this as a desirable trait, but I cannot see how this can be anything but the most questionable learning outcome possible.

Much of the rhetoric surrounding IDS programmes and thematic curricula like that at the University of Melbourne is compelling in terms of student development and the practical utility of knowledge in the wider world, and the models appear on the surface to offer quality instruction on interesting topics, and with considerable freedom for students to choose their own paths. Nevertheless, the past several years have seen a growing string of closures, retractions and returns to disciplinary models of even some of the most high profile and well regarded programmes, such as William Newell and Julie Thompson-Klein's flagship IDS programmes, Melbourne University's format, and Murdoch university (Henry 2005; Thompson-Klein 2010b; Marshall 2010; Newell 2010; Davis 2011; Wexler 2012). Why do such programmes often founder? My hypothesis is that there is an under studied disconnect between these high goals and the actual ways in which humans develop and identify expertise, transfer and categorise knowledge, and collaborate; that there are constraints on these which have more to do with psychology than the traditionalism or commercial interests or neo-liberal agendas that are often implicated as the cause of failure (Wexler 2012). Further, I believe that a curriculum developed with focus on these constraints can help reach the grand goals of interdisciplinary higher education, likely a bit slower, but in a more sustainable way.

SoITL (Scholarship of Interdisciplinary Teaching and Learning)

The Scholarship of Interdisciplinary Teaching and Learning is characterised by what Diana Laurillard calls 'teaching as a design science'; that is, research about teaching gathered by doing it and then reporting on the process/results (Laurillard 2012: 21–23). SoITL studies are typically heavy on data in the form of examples of practice, while notably light on theory of interdisciplinarity. Often what theory is present cites prominent work in HTRoI, and is not the focus of the study. This approach has no clear regional or institutional centre. Previously there was considerable focus in the USA, with the AIS holding an annual conference on SoITL, but recently there has been a considerable amount from Australia and the UK. It is difficult to get an accurate idea of how much of this research truly exists, however, because much of it is not published in the literature on education, but within the literature of the disciplines in which the teaching takes place. There may yet be many excellent examples of research on interdisciplinary teaching which have gone unnoticed by the education community.

Studies in this area provide case studies of alleged interdisciplinary learning and teaching in practice, often focusing on the success or failure of particular methods in particular

settings (Lattuca *et al.* 2004; Peters 1999; Beilin and Bender 2010; Marshall 2010). Case studies such as these can be incredibly useful for a number of reasons, but it must also be considered that no single case, or even small number of cases studies, are sufficient to develop or to validate a generic model of interdisciplinarity that would span all disciplines and all universities, or even most. To do so invokes the *individualistic fallacy*; that of drawing conclusions about a collective from data gathered only about individuals. Case studies of interdisciplinarity are problematic as a source of evidence due to their highly situated nature, as well as due to the typically borrowed or assumed definitions of interdisciplinarity that they use. There is little coherency from one study to the next concerning which notions of interdisciplinarity are being reviewed or applied. This makes any attempt to generalize about interdisciplinarity from the evidence of this tradition unlikely, nor has doing so typically been the goal.

Aside from being part of a long academic tradition of sharing good practice, and which is surely a good thing in its own right, what research of this tradition does best is to provide valuable tests of different models of interdisciplinarity. In terms of defining interdisciplinarity though, it is not an effective tradition to draw from. To develop or corroborate a general approach to interdisciplinarity from SoITL sources would require a major undertaking of aggregation of results, interpretation of similarities, and critical review of methods in each case. Such an operation would not be unhelpful to understanding interdisciplinarity, especially in practice, but it is beyond the scope of this thesis.

RoIR (Research of Interdisciplinary Research)

There is a long tradition of post-project reviews of large ‘interdisciplinary’ projects. This area of RoI actually pre-dates much of the HTRoI work, but it has typically lacked a coherent or active theoretical aspect, borrowing from HTRoI in most cases.[18] Historically RoIR studies have been almost entirely within the Science, Technology, Engineering and Medicine (STEM) disciplines, where large expensive collaborations across many specialist subjects and professions have been typical for several decades (Thompson-Klein 1990). There is no clear geographical centre for these studies, though several notable recent ones have come from the UK and Europe. The format of the studies is very similar in each case. One or more large scale ‘interdisciplinary’ research projects are selected, and the process

[18] A few notable recent efforts have resisted this trend (Bruce *et al.*, 2004; Griffin *et al.*, 2006)

of doing the interdisciplinary work is charted and evaluated throughout, largely through interviews and focus groups with the participants.

RoIR studies offer a wealth of empirical data for not only evaluating the processes used in specific settings, but for developing an evidence-based definition and model of interdisciplinarity itself. This has not been how they have been applied, however. Rather the work in this area has relied on mostly existing HTRoI accounts in abbreviated forms, typically in the introduction to the studies, and typically with limited critical assessment (e.g. Lyall and Tait 2001; Kandiko and Blackmore 2010; Modo and Kinchin 2011; Bruce *et al.* 2004). One of the chief hypotheses of my thesis is that we could work in the opposite direction, using the data from these studies as one source of evidence for development of a model of interdisciplinarity.

Because the subject of most RoIR studies is projects with set goals and timeframes, many are able to discuss not only the inception and process, but typically also whether the outcomes are integrated or multidisciplinary, and whether the processes used are ultimately successful and to what degree (thereby completing the 'research triangle'). This aspect offers a substantial advantage over HTRoI and most ERoI literature, which often fall short of much needed justification for the extra expense of interdisciplinary processes without this information.

Like SoITL, much of the work here can be characterised as case studies. Case studies of interdisciplinary research, however, are significantly more generalizable due to several factors. There is much more coherency across each study. Although the particular projects and disciplines involved change in each case, and approaches to interdisciplinarity also vary to some degree, certain uniformities of the research project environment in a generic sense make comparison across RoIR studies much more defensible. Each project presumes that interdisciplinarity is:

- being performed collaboratively,
- in a research setting,
- with the purpose of reaching a pre-set goal or solving a given problem,
- within a specific frame of time,
- within a specific budget,
- with certain set milestones and oversights.

RoIR studies also typically employ cases studies as a broad research *design* rather than a narrow research *method* (as in SoITL). This means that within a single case study there are typically a range of interviews, surveys, document analyses, focus groups and participant observations. The final aspect that suggests RoIR literature to be more generalizable is that much of the results of RoIR studies correlate well with the results of other RoIR studies.

Although studies in this category offer considerable benefits to research of interdisciplinarity, they are also relatively less common, presumably due to the size, complexity, cost and timeframe involved in each. There have also been a few recent studies which blur the line between RoIR and ERoI by reviewing the interdisciplinary conditions around research *proposals*. Proposals are more readily available for review in large numbers, allowing for consideration of the interdisciplinary nature of research within a much smaller timeframe and project size. But these also suffer from a considerable lack of the supporting interview and process related evidence of the larger RoIR studies, as well as the obvious fact that these cannot consider the results of the interdisciplinary projects as they have not been completed. I have reviewed two of the most recent large scale RoIR studies conducted within the UK:

- *Interdisciplinary integration in Europe: the case of the Fifth Framework programme* (Bruce *et al.* 2004).

  This project compared six case studies of large collaborative and allegedly interdisciplinary research projects. The study included discussions, workshops, surveys, detailed case studies of the process in each project, and post-project meetings in each case to review the quality of results, whether integration had been achieved, and what lessons could be learned.

  The researchers developed a chart of ideal qualities of an interdisciplinary researcher:

  - "Curiosity about, and willingness to learn from other disciplines
  - Flexibility and adaptability
  - An open mind to ideas coming from other disciplines and experiences
  - Creativity
  - Good communication and listening skills
  - Ability to absorb information and its implications rapidly
  - A good team worker" (Bruce *et al.* 2004: 464).

Although these skills/traits were derived almost entirely from projects in the STEM disciplines, we will see later that when Medieval Studies researchers are asked the same question the results are very similar (chapter7). These also appear to be 'traits' more than skills (also a trend in some of my interviews). This may necessitate a curriculum of interdisciplinarity which can account for, and perhaps develop these. Whether these are truly 'traits', or can be approached as skills will be examined in the following chapters. Further they found that the best teams already knew each other, and had grown out of conferences and contacts, but that there were issues doing this because building a team was slow and difficult, and could be wasted time if a proposal was not funded (463-4). The concept of 'building a better team' through undergraduate curriculum models will be examined in chapter 5.

One interesting supplementary finding of the report was that self-identification of projects as interdisciplinary was highly unreliable in terms of actual interdisciplinary process or outcome.

- *Interdisciplinarity in Interdisciplinary Research Programmes in the UK* (Griffin *et al.* 2006).

This project was composed more heavily of interviews than Bruce *et al.* Although this approach to understanding interdisciplinarity can be problematic if applied too holistically, the approach here was largely abductive, that is the interview data was used to isolate trends in responses and to formulate a broad hypothesis of patterns, rather than to form a comprehensive definition of interdisciplinarity from an insufficient sample. This represents a more reflective and self-aware application of interview data.

This project was also unique in its focus on 'broad' interdisciplinarity. Each project, at least to some degree, combined arts and humanities subjects with social science and science subjects. The two research projects evaluated were co-funded by the Arts and Humanities Research Council (AHRC) and Economic and Social Research Council (ESRC) in one case, and the AHRC and the Engineering an Physical Sciences Research Council (EPSRC) in the other.

The researchers concluded with a list of 29 trends which emerged from their interviews. Although all of these offer useful insights into actual perceptions and

practice of interdisciplinary work, I have only listed here the most salient for this thesis.I have kept the numbering as it appears in the original report:

1. Interdisciplinarity is not clearly defined either by the research councils or by the research programmes; instead, the term tends to be used in a declarative manner, often interchangeably with multi-disciplinarity. Both among researchers and among the research councils it was common to talk about ‘crossing disciplinary boundaries’, and neither ‘trans-‘ nor ‘post’-disciplinarity were much in use.
2. Interdisciplinary research was closely linked to collaborative research.
3. The research councils in the UK are organized around knowledge domains (eg arts and humanities; economic and social sciences etc) which impact on the research for which they consider themselves accountable, and on how they assess research.
6. The research councils operationalize interdisciplinarity through thematic priorities which are closely aligned to international research agendas such as those of the European Commission, thus indicating the impact of the building of the European Research Area networks on national research agendas.
7. The consideration of users, the issue of raising public awareness and of engaging with wider society are viewed as part of the new (interdisciplinary) research regimes.
8. Post-award auditing of research projects, particularly for their interdisciplinary dimension, is not yet developed by the research councils, thus making the demand for interdisciplinarity a matter of researcher preference and potentially nothing but a paper exercise.
10. The researchers experienced the programmes as fostering interdisciplinarity but it was also clear to both researchers and programme directors that the take-up of what the programmes had to offer was a matter of individual researcher disposition, enthusiastically embraced by some and rejected by others.
11. A lack of coordination of synergy between programmes and projects, even within single research councils, was noted as leading to researchers’ reinventing the wheel or working in parallel rather than collaborating.
12. The researchers indicated that interdisciplinary work did not supersede but ran in parallel with their home-discipline-based research.
13. The researchers could be divided between those who saw themselves as working in a new interdisciplinary field such as Human-Computer-Interaction (HCI) and those who did interdisciplinary research in addition to being in a traditional discipline.
14. The desire to work in an interdisciplinary way with others occurred in the following four contexts which were not necessarily mutually exclusive: within interdisciplinary disciplines; in adjacent disciplines; due to affective affinities; and due to ideological affinities.
15. Prior working relationships were in most cases key to the establishment of interdisciplinary research teams.
16. Those who undertook interdisciplinary research were characterized by: careers that had involved moving across disciplines; an open disposition towards other disciplines, their terminologies, methods, and ways of thinking; previous histories of interdisciplinary collaboration; locations that enabled cross-disciplinary working; having networks across a range of disciplines; a willingness to communicate across disciplinary divides; a

certain independence from career-oriented thinking and working (e.g. not having to use the research for RAE purposes); being more senior in their fields.

19. Interdisciplinary research was viewed by all as not conducive to one's academic career – academic careers required uncompromising embedding in a single discipline.
21. The attempt to conduct interdisciplinary research within research structures that are predominantly disciplinary, led to strategic divisions of labour within interdisciplinary research projects which frequently meant that researchers stayed in their disciplinary niche, worked in parallel, and published separately. Here interdisciplinarity never went beyond sharing knowledge and methods.
23. Interdisciplinary research was viewed by many as lacking scientific credibility and therefore being seen as undesirable.
24. To conduct interdisciplinary research effectively, researchers were thought to need good interpersonal skills, good communication skills, openness towards others' methods and terminology, a willingness to work towards developing a common language.
25. Interdisciplinary research requires more time than discipline-based research and a greater degree of process as opposed to product orientation.
26. The researchers in the projects saw interdisciplinarity as important for future research but recognized that institutional research structures, funding and assessment will have to change significantly to enable effective interdisciplinary research.
27. Researchers were divided regarding the need for a top-down approach to interdisciplinarity as opposed to a bottom-up one. They were clearer about the detrimental effects of current research infrastructures for interdisciplinary research than they were about how changes to those infrastructures might actually facilitate such research.
28. The researchers recognized that research methods cement researchers into disciplinary dispositions and that these can be overcome by a greater understanding of a range of research methods" (74-76).

What seems to emerge from this list is that the range of ideas about or approaches to interdisciplinarity in practice, which have been taken as justification for pluralism by some, may be more effectively viewed as a range of factors for developing a *singular* interdisciplinary practice. Pluralism only makes sense if each factor were considered separately as a different type of interdisciplinarity, but it is clear that the participants have all been referring to the same projects and activities. Of special importance is conclusion 11, because this effectively restates what the purpose of my thesis is, to develop curricula which can, hopefully, eliminate or greatly reduce this issue.

ERoI (Educational Research of Interdisciplinarity)

In the wake of relative silence on interdisciplinarity from within the Educational Studies community itself for most of the span of since 1972, there has been an apparent explosion of publication. Since 2007 there have been at least three edited collections within

Educational Studies concerning interdisciplinarity (or moving beyond disciplinarity), as well as a substantial renaissance of other curriculum focused research on the subject. Of the publications in these three collections several are by design SoITL. Of the remaining works several can be described as surface considerations of interdisciplinarity in relation to the author's regular area of educational research, such as research-teaching linkages, academic ethics, threshold concepts, new programme assessment, etc. (Illingsworth 2009; Littlejohn and Nicol 2009; Lorenzo-Zamorano 2009; Van der Velden 2009; Irving 2009; DeZure 2010; Casey 2010; Pfirman and Martin 2010; Newell 2010). These studies discuss interdisciplinarity in relation to these specific topics, but do not engage significantly with wider learning and teaching issues of curriculum design. There are also a few notable early precursors to the recent rise in ERoI literature, the most well known being William Newell (Newell and Green 1982; Newell 1994). Newell's work has consistently returned to the place of interdisciplinarity in the curriculum, but has also not engaged with the wider literature on learning and teaching.

To put the recent increase in ERoI publications in the context of the wider higher education research community, I reviewed the collected SRHE (Society for Research into Higher Education) abstracts for 2013 (Visser-Wijnveen 2013a, 2013b, 2013c). The SRHE abstracts collection compiles the abstracts of approximately 750 publications in higher education research across 134 journals in chiefly the UK, Australia and Europe, and some of Asia (notably only publications in English).[19] My analysis was based first on the topic index, simply looking for 'interdisciplinarity' and its common correlates 'multi-disciplinarity', transdisciplinarity' and 'cross-disciplinarity'. In order to be generous with the use of terms, I also searched for abstracts discussing disciplinarity in a way that suggested transcending or questioning it, as well as discussions of knowledge transfer, collaboration or inter-professional education which appeared to at all relate to interdisciplinarity:

[19] There is a separate compilation of a similar nature which is focused on American publications which I did not review, but in which I would anticipate slightly more presence of interdisciplinarity due to the long standing focus on broad liberal education in the US system.

Topic Heading	Journal	Author	Title
Interdisciplinarity	Higher Education Research & Development	Ryan, *et al.*	Developing research capacity among graduate students in an interdisciplinary environment
	London Review of Education	Kandiko	Leadership and creativity in higher education: the role of interdisciplinarity
	British Journal of Educational Studies	Thomas	Disciplinarity and the organisation of scholarly writing in educational studies in the UK: 1970-2010
	Higher Education Research & Development	MacKinnon, *et al.*	Interdisciplinary science research and education
Interprofessionalism	Journal of Interprofessional Care	Zorek & Raehl	Interprofessional education accreditation standard in the USA: a comparative analysis
Multidisciplinarity	Learning and Instruction	Noroozi, *et al.*	Scripting for construction of a transactive memory system in multidisciplinary CSCL environments
	Teaching in Higher Education	Wollf, *et al.*	Integrating multidisciplinary engineering knowledge
Transdisciplinarity	Higher Education	Felt, *et al.*	Growing into what? The (un)-disciplined socialisation of early stage researchers in transdisciplinary research
Collaboration	Higher Education Policy	Duysburgh, *et al.*	Collaboration in a multidisciplinary, distributed research organization: a case study
	Higher Education	Lewis, *et al.*	The how and why of academic collaboration: disciplinary differences and policy implications
	Journal of Interprofessional Care	Aase, *et al.*	Teaching interprofessional teamwork in medical and nursing education in Norway: a content analysis

Figure 1.3 Abstracts of Interdisciplinarity

This was not meant to be a definitive analysis, but the results are fairly clear, there was not much publication dealing with interdisciplinarity or related topics: only 0.015% of the total contributions. For comparison, there were nearly three times as many articles about 'discourse analysis' (11) and nearly four times as many about 'first year students' (14) as there were on 'interdisciplinarity' specifically (4). The apparent explosion of ERoI literature may in fact be deceptive in a broader sense, even though it is substantial in terms of RoI literature itself.

Legacy of HTRoI

The new wave of educational research on interdisciplinarity, though evidence-based, practice oriented and in general quality research, is often still beholden to tacit ideas about interdisciplinarity and the disciplines that have carried over from the previous HTRoI work. One consistent indication of HTRoI received wisdom is the use of uncritical or marginally critical citation of these sources to define interdisciplinarity (Aram 2004; Chettiparamb 2007; Spelt *et al.* 2009; Littlejohn and Nicol 2009; Lorenzo-Zamorano 2009; Illingsworth 2009; Irving 2009; Van der Velden 2009; Blackmore and Kandiko 2010; Brack, Schmidt, and MacKinnon 2010; Casey 2010; DeZure 2010; Pfirman and Martin 2010; Davies and Devlin 2010; MacKinnon, Hine, and Barnard 2013). Thompson-Klein in particular is cited

in many ERoI accounts, and in very few is this critical. This legacy is not uncontested, however. Some ERoI accounts directly call into question the assumptions of the HTRoI studies (Weingart 2000; Rowland 2006; Greaves and Grant 2010; MacKinnon *et al.* 2010; Bamber 2012a; Trowler 2012b). Although a strong legacy of the HTRoI theory continues in much of the ERoI literature, there is also a growing resistance and possibly the beginning of a new core focus in the understanding of disciplinarity.

Pluralistic approaches to interdisciplinarity appear to be somewhat less frequent in ERoI, but are still present in several widely cited examples (Lattuca 2001; Van der Velden 2009; Davies and Devlin 2010). In much of the ERoI literature though, pluralism of interdisciplinarity has not been part of the discussion at all. This may suggest a refutation by omission; that such pluralistic models may seem less appealing when curriculum or pedagogy are the focus of discussion.

The competency approach to interdisciplinarity has also not been as prominent in ERoI, but just as with pluralism, it has not been absent entirely. The continued promotion of Interdisciplinary Studies programmes and broad thematic restructuring of curricula are the most prominent examples (Newell 2006, 2010; MacKinnon *et al.* 2010: 35; Golding 2009; Wexler 2012; Fiksdal 2013). Breadth without depth has been strongly contested within much of the theory-based ERoI literature though:

> "Highly competent proficiency in a single discipline is the only acceptable basis for interdisciplinary success" (OECD 1998: 18 cited in Huutoniemi 2010: 311).
>
> "A basic premise of quality interdisciplinary work is that it satisfies quality standards arising from the disciplines involved" (Boix Mansilla 2006: 75).
>
> "Also central to the proposed definition is the upholding of disciplinary standards in interdisciplinary work. Disciplinary understanding builds on knowledge and modes of thinking that have survived the scrutiny of expert communities using commonly agreed upon methods and validation standards" (Boix-Mansilla and Duraising 2007: 219).
>
> "The danger, however, is that in seeking to avoid interdisciplinary contestation transdisciplinarity can lead to a collapse or denial of the forms of critique that characterize the disciplines. It is as if the lowest common denominator is sought in order to reach consensus, rather than facing the challenges of disciplinary difference" (Rowland 2006: 95).

Disciplinary essentialism maintains a strong tacit presence in ERoI (Spelt *et al.* 2009; Casey 2010; Pfirman and Martin 2010; MacKinnon *et al.* 2010; Brack *et al.* 2010).

However, in the case where essentialism is explicitly challenged in ERoI it tends not to present the sort of internal contradictions with which the HTRoI literature has had problems (Rowland 2006: 95; Bamber 2012a; Trowler 2012b). For example, Stephen Rowland (2006) defined interdisciplinarity by viewing it a site of contestation between and of the disciplines, which could be seen as an essentialist approach, but Rowland also regarded the disciplines as sites of contestation of themselves as part of the same definition. Echoing Piaget (1972), Rowland states, "Thus interdisciplinarity is nothing new. It reminds us of the contested nature of knowledge and the continual need to challenge one's own assumptions and to be aware of how one's standpoint might be viewed by those who do not share it" (Rowland 2006: 96). He suggests that there can often be more in common between Marxian theorists across several disciplines than any of these have with other theorists in their 'home' disciplines. Whether bridging disciplinary divides via such overarching theoretical structures as Marxism or Feminist Theory really constitutes interdisciplinarity or something else entirely remains an open question (and one there is not the space to tackle here).

Several of the most coherent ERoI works in recent years have been critiques of disciplinarity, particularly of disciplinary essentialism. The 2012 collection *Tribes and Territories in the 21st Century: Rethinking the significance of disciplines in higher education* is one example. While focused notionally on the disciplines, a merging into notions of interdisciplinarity was explicit in several chapters, and implicit in others. In the same vein Jan McArthur (2010) offers a cogent critical view of interdisciplinarity as an 'emancipation' from the disciplines by suggesting that the disciplines themselves are both critical and emancipatory. It remains to be seen what and how much effect such a problematising of the core of disciplinarity will have on subsequent RoI.

Approaches to Interdisciplinarity in Curriculum

Interdisciplinary curricula take on a variety of forms in the literature. There are some uniformities though, the most prevalent being a call for explicit teaching of interdisciplinarity at some point, and the development of a set of interdisciplinary skills which are to be part of this teaching. This pattern is present not only in the ERoI literature, where curriculum and pedagogy are the focus, but also in a growing amount of the HTRoI literature, further blurring the lines between the categories. Spelt *et al.* take a learning outcomes approach, as do several of the reports from Harvard's widely cited 'Project Zero' project on interdisciplinarity in practice (Nikitina 2005; Boix-Mansilla and Duraising 2007; Spelt *et al.* 2009). Supporters of IDS programmes have proposed or developed discreet

introductory or capstone courses to teach interdisciplinary skills (Newell 2006: 45; Repko 2008). MacKinnon *et al.* (2010: 243) call for all students to be taught interdisciplinary thinking and awareness of broader subjects as undergraduates, before too much disciplinary thinking sets in (this is a concept which I will return to in the discussion of expertise and 'cognitive entrenchment' in chapter 5). Kate Chanock (2010) promotes a skills based learning of interdisciplinary generic writing skills, embedded within each discipline, thereby promoting interdisciplinary learning through redundancy.

There is not as much consensus among these studies, however, about how or when interdisciplinarity should be taught. Moreover, many of the skill sets listed for interdisciplinary thinking or practice are derived from HTRoI sources or from common sense assumptions. There is little indication, for example, that any identified sets of interdisciplinary skills are derived from the empirical studies in the RoIR or SoITL literature, or any other empirical source. A recent analysis of the literature on interdisciplinarity by Elsbeth Spelt *et al.* counted only ten studies out of 309 surveyed that used empirical methods to develop learning and teaching strategies for 'interdisciplinary thinking', and I do not concur that even all of these qualify, though I would also add a few more to the list (Spelt *et al.* 2009). Spelt *et al*. describe the methods employed by these ten studies as typically, 'surveys, interviews, observations, product appraisals, and reflections on experiences', several of which I have already identified above as problematic in terms of validity or reliability for defining interdisciplinarity (2009: 371).

New Directions

There have been a number of novel approaches to interdisciplinarity recently that fall around the margins of ERoI and HTRoI. These have at least in part been my inspiration for the directions I have looked in for further evidence about interdisciplinarity:

Ray Land (2012) has proposed that interdisciplinarity can be seen as a special case of 'threshold concepts'. Succinctly, threshold concepts are important and also difficult to acquire aspects of knowledge or skill in a particular discipline, which often lead to an epiphany or advancement of understanding once they are finally reached. Meyer and Land (2005) proposed that within the disciplines these are relatively stable elements that each student must eventually master in order to progress to deeper understanding. In terms of interdisciplinarity Land suggests that grasping certain interdisciplinary linkages between disciplines is much the same. Land's work appears to parallel much of the existing

empirical research on expertise, which is also concerned with qualitative distinctions between levels of understanding/skill.

Justin Greaves and Wyn Grant (2010) have approached interdisciplinarity in Political Science and Biology as a question of a unity of academic knowledge, which they propose would allow better understanding across disciplines. A similar suggestion is made by Maura Borrego and Lynita Newswander (2010). Greaves and Grants' argument is that there is no real qualitative distinction between the natural sciences and the social sciences outside of consideration of the level of consensus likely to be achieved among practitioners. This is not a new idea, indeed Greaves and Grant attribute it to several other recent philosophers. It is, however, a contested and not terribly popular approach, especially when the humanities are also considered, which Greaves and Grant did not address. This has the potential to be a very strong argument for a generic concept of interdisciplinarity, but it would benefit from being extended to a broader scope and more solid foundations. It is also important to distinguish if and how this approach differs from a number of 'transdisciplinary' theories of transcending the disciplines. This will be a chief focus of the chapter on epistemology.

Svetlana Nikitina (2005) approached the subject in terms of language and cognition research by first problematising the existing understandings of interdisciplinarity as underdetermined (she did not use the term), and then asking whether cognitive analysis of the language of interdisciplinary interaction showed any discreet differences from ordinary dialogue. The study was compelling for a number of reasons. First, Nikitina's hypothesis was that interdisciplinary cognition was no different from ordinary dialogic interaction, that it may not be something unique or special. She also relied on a very different source of external research, the linguistic and categorical studies of Bakhtin and Lakoff, moving the analysis of the nature of interdisciplinarity away from its humanities core. Nikitina's account is also one of the only ones to openly acknowledge its own circular, and therefore less reliable, methodology of using self-identified interdisciplinary groups. Inspired by this work, I have also approached interdisciplinarity in terms of the psychology of categorisation (though less focused on language).

The only other academic that I am aware of to substantially consider the psychology of interdisciplinarity is Rainer Bromme (2000). Bromme focused on the psychological factors of interdisciplinary skills, the psychological nuances of expertise, collaborative communication, and the categorisation concepts: in short, Bromme's article presaged the

effective research agenda of this thesis, though in a less extensive format. Bromme did not problematise the prevailing HTRoI understanding of interdisciplinarity, however, and as such, his conclusions veered wide of where they might have gone otherwise. This thesis owes Bromme and Nikitina each substantial credit for helping set the course it has taken. Unfortunately neither work has been substantially integrated into subsequent RoI work, though each are cited from time to time.

Concluding Remarks

A Note on Transdisciplinarity

The general implication of transdisciplinarity is of something beyond disciplinarity or even interdisciplinarity. However, it has been taken to have such a wide range of uses in different sectors of higher education and RoI, that it is effectively impossible to know which is being employed in any case where it is encountered. There is, however, one use of the term which is more consistent with regard to the specific focus of this thesis: development of new curricula in the general higher education context. This is transdisciplinarity as a complete or near complete breakdown of disciplinary divisions of knowledge, often tied to emancipatory notions of a unity of knowledge or undifferentiated options (Gibbons *et al.* 1994; Thompson-Klein 2005b, 2010a; Nicolescu 2012; MacKinnon *et al.* 2013). I refer to this approach as 'radical transdisciplinarity', and although it does not appear in the literature with great frequency, it is often boldly stated and influential when it does. One such example is the 'mode 2' knowledge of Gibbons *et al.* (1994).[20]

Bringing it Together, Agreeing to Disagree

A few concepts of interdisciplinarity do appear to share a significant degree of consensus across the traditions. Conclusions that interdisciplinarity is collaborative and skills-based, and that students should be trained in these, are perhaps the most consistent statements about the topic across ERoI, RoIR and even HTRoI in recent years. If there is consensus here across traditions though, why is there no consensus on a definition of or approach to interdisciplinarity in general? The answer appears to lie in the concurrent continuation of oppositional models and approaches which still challenge these conclusions, and also with

[20] Mode 2 knowledge suggests that a new way to view knowledge in the modern world is that it transcends disciplines and 'pure' academic study, moving to explicitly project-based and practice-centred application as the main form of activity. Although there are a number of compelling aspects of mode 2, it has been rightly criticised for being both not new and not empirically supported. It is the necessity of eliminating or transcending the disciplines that is of concern in this thesis. Examples of transcending the disciplines given in the text suffer largely the same historically and self-identified issues as the HTRoI literature, in that Gibbons *et al.* personally and seemingly arbitrarily determine which aspects of the examples given are disciplinary and which were transcendent.

the limited focus on curriculum design across all the traditions until very recently. The consensus is therefore tenuous and contested and has not been tested by praxis in many cases. Pluralistic, essentialist, and competency concepts of interdisciplinarity continue to share popular support alongside generic, collaborative and skills/mastery based approaches. In many cases these are even intertwined with or used to explain each other (Bromme 2000; Spelt *et al.* 2009; MacKinnon *et al.* 2010; Davies and Devlin 2010).

The difficulties with much research in the ERoI tradition, as well as recent HTRoI and some RoIR, continues to be one of insufficient amounts of the *right kind* of evidence, leading again to underdetermination. For example, a recent article that looked at graduate approaches to interdisciplinarity in the sciences and engineering concluded that interdisciplinarity is in practice collaboration based, that there are particular skills that facilitate this, and that these should be taught to graduates (Modo and Kinchin 2011). Though coherent and compellingly argued, the basis for these conclusions was insights derived entirely from an array of HTRoI sources. Since the HTRoI sources have been called into question as reliable evidence, this would suggest that this article is compelling on grounds of common sense alone, not on the evidence offered to justify it. How then do we know if we should trust these conclusions?

The need for expertise has been strongly supported, but also either tacitly or explicitly refuted. The concept of a single generic model of interdisciplinarity has been disputed by a plethora of pluralistic models. The open and flexible nature of the disciplines has been well established and largely agreed to, but not without tacit assumption of their rigidity operating in tandem. Empirical evidence exists within the literature, but is often limited in scope or is of questionable reliability. It must also be determined if and in what way anything interdisciplinary is not also a normal function of disciplinarity. Although many attempts have been made to describe what this may be, none seem both compelling and well evidenced at the same time. Further, accounts which suggest that interdisciplinarity is not something special or separate from normal disciplinarity continue to appear periodically, and are often very compellingly argued (Piaget 1972; Fish 1989; Weingart 2000; Nikitina 2005; Rowland 2006; Boix-Mansilla and Duraising 2007)

The nature and practical value of interdisciplinarity are both substantially underdetermined at this time; many theories appear to be equally justifiable given the available evidence. But this underdetermination appears to be of the unjustified variety, which means there should be ways to overcome it. In order to build a model of interdisciplinarity which can

work from theory, through evidence, and into practice, the tacit assumptions about these approaches needs to be stripped away and each needs to be examined from first principles, using evidence that is outside of the alleged practice itself. That is what I hope the following chapters will provide.

Chapter 2: Epistemology & Academic Knowledge

Introduction

This chapter serves a dual purpose of establishing my own ontological and epistemological base from which my methods and analysis of studying interdisciplinarity derive, and also of establishing a deeper understanding of the underlying epistemological ideas which are critical to developing a model of interdisciplinarity. Concepts in the interdisciplinarity literature such as pluralism, disciplinary essentialism, the distinction between the humanities and the sciences, and interdisciplinarity as 'greater than sum of parts' can all be taken back to deeper epistemological roots. The nature of interdisciplinarity and the questions of epistemology are in many ways the same: both problematise how we define and structure knowledge and knowledge production, how we might view a single concept from several seemingly incommensurable perspectives, and whether communicating across these is really possible. Although the epistemological nature of interdisciplinarity is often discussed in an abstracted form in the literature, it is seldom analysed *as* epistemology, and I believe this is one cause of the continuing lack of consensus.

The epistemological approach I take in this thesis is that of naturalised pragmatism. In this chapter I will explore what pragmatism is, how it relates to other epistemological stances, and what the naturalised version of pragmatism entails, paying attention to points where this ties into concepts of interdisciplinarity. Pragmatism is largely a critique of other epistemologies, notably postmodernism and positivism, and so in exploring pragmatism I will also consider other standpoints, and their application in the interdisciplinary literature. After looking at what pragmatism *is*, I will explore what it says about two epistemological problems of interdisciplinarity: the perceived split between science and the humanities often known by the metaphor of the 'two cultures', and the claim that interdisciplinarity solutions can be 'greater than the sum of their parts'.

One of the most substantial and long-lived divides in the academic world is that between the sciences and the humanities (with the social sciences usually falling to the humanities side), what C.P. Snow famously called the 'two cultures' in 1959 (Snow 1961; Trowler *et al.* 2012). The rationale for this divide is based on the perception of a discreet epistemic difference between humanistic knowledge and scientific knowledge, something Snow lamented, but which many others have regarded as valid or essential to academia (Messer-

Davidow *et al.* 1993; Moran 2010; Parker 2002, 2008). Hans-Georg Gadamer expressed this succinctly:

> "Hence the human sciences are connected to modes of experience that lie outside science: with the experiences of philosophy, of art, and of history itself. These are all modes of experience in which a truth is communicated that cannot be verified by the methodological means proper to science" (Gadamer 2006: xx).

The assertion relies on creating a separate identity for the humanities by placing essentialist restrictions on the methods 'proper to science', and excluding such methods from the humanities and social sciences. This is a process of 'othering' much the same as some HTRoI theorists have done with disciplinarity and interdisciplinarity, and it has led to a similar 'us versus them' result that is apparent in the wealth of literature in recent decades about the 'crisis in the humanities' and the 'science wars', sparking some acerbic reactions such as the 'Sokal affair'.[21] All of this makes one of the most fundamental impediments to interdisciplinarity, communication across the science/humanities divide, an epistemological problem, and specifically one which needs to be addressed by examining what 'scientific' knowledge is. The divide is defended and maintained in a number of anti-scientistic sentiments from postmodern approaches to knowledge, and to interdisciplinarity, which appear to be based on a poor historical understanding of the core nature of scientific thinking or method (Kuhn 1996: 205; Thompson-Klein 1996, 2010b; Peters 1999; Gadamer 2006: 442–443; Rossi 2006: 24–46; Moran 2010: 74). Examining this will require a brief foray into the history of the scientific method, but doing so will provide a stronger basis for challenging both disciplinary essentialism and pluralism in interdisciplinary theory.

Interdisciplinarity is also often regarded as having intrinsic value by producing solutions which are 'greater than the sum of their parts' or addressing problems which are presumed to be irreducibly complex, such as climate change or social welfare that interdisciplinarity provides (the 'betterness' claims mentioned in the previous chapter). What these approaches to interdisciplinarity consistently do not do is *demonstrate* that any of the problems claimed as too big for a single discipline actually are so, or that the interdisciplinary solutions actually *are* better. Rather, this is taken as a self-evident (Newell 2001; Boix-Mansilla and Duraising 2007; Thompson-Klein 2010). These concepts of

[21] The 'Sokal affair' was a controversial article published in the journal *Social Text* by physicist Alan Sokal. The article was intentionally circular and unsupported, containing many postmodern buzzwords and rhetorical statements. Sokal later publically admitted to the hoax, claiming that postmodernism was 'fashionable nonsense' (Lezard 2010). For more on the 'crisis in the humanities' see Chapter 4.

irreducibility are called holism in epistemological terms, and are opposed to the notion of reductivism, which is the idea that anything can be reduced to its components parts, and can then be understood by how these combine to make the whole. Below I will consider one of the main arguments in favour of holism, and how this relates to 'greater than the sum of parts' arguments for the definition of interdisciplinarity. Further, the lack of demonstration of 'betterness' in application violates the most fundamental aspects of pragmatism, as we shall see below.

Pragmatism & Naturalised Epistemology

One of the main threads of epistemological and ontological development in the past century has been that of pragmatism. The movement is most commonly associated with Charles Sanders Pierce, William James, John Dewey as progenitors, and W.V.O. Quine, Thomas Kuhn, Hilary Putnam, and Richard Rorty more recently (Stanford 2013; Truncellito, n.d.). Not all pragmatists self-identify as such though, nor are all who claim to be pragmatists clearly so in all cases. Kuhn did not self-identify as a pragmatist, though his theory of paradigms bears many core similarities to this tradition. Conversely, Richard Rorty is sometimes considered a postmodernist due to his arguably relativist stand on many issues (Grayling *et al.* 2005). Some of Michele Foucault's work, specifically *The Order of Things*, can be read as distinctly pragmatic although he is typically considered a postmodernist. Pragmatism was chiefly developed in an American context, though there are certainly pragmatists elsewhere; Jurgen Habermas is typically considered a pragmatist for example (Bohman and Rehg 2011).

The most core and most agreed on defining feature of pragmatism is the insistence on utility or usefulness of theories, models, solutions, or conclusions as the penultimate determiner of truth-value (Almeder 2007). For any pragmatist, what makes a conclusion 'true' is ultimately defined by whether it can be demonstrated to be effective or useful. That same core focus is upheld in my approach to interdisciplinarity in the curriculum as a pragmatic process: concepts of interdisciplinarity which are not clearly effective or useful are therefore not acceptable as good definitions. Utility is not the only important aspect of pragmatism, however. Bruce Kimball lists six key features of pragmatism:

1. "Pragmatists are fallabilists: they recognise that any possible assertion about what is true or right might well be in error.

2. They advocate the experimental method of inquiry, a method they take as having egalitarian implications since it is a method anyone can be taught to utilize.
3. They understand judgements of truth or right to be intersubjective, assertions that are warranted by the judgement of a community of inquirers not by a single individual's judgement.
4. They argue that human beings are part of the natural order, organisms in dynamic interaction with their environment.
5. They think that purpose is intrinsic to thought and inquiry: truth is a matter of habits that guide us successfully toward the attainment of our ends.
6. They believe inquiry is inherently normative: thinking cannot be separated from preferring and choosing" (Kimball 1995: 29 cited in (Allan 2004: 128).

Kimball's list is a good starting point, though it is important to note that there are nuances within pragmatism regarding how usefulness or utility should be defined or verified. The list suggests that a key feature of pragmatism is the use of the experimental method, which strongly suggests that usefulness is tied to reliability via empirical modes of consensus and justification. This is most commonly how pragmatism seeks to reduce (but never eliminate) underdetermination, by relying on well-formed evidential structures to support that a proposed solution is not just useful, but is *more* useful than less justified variants. Some pragmatists, however, such as William James and Richard Rorty, have taken more relative or subjective views of this, allowing that what is useful, and therefore epistemically true, can be defined much more individualistically according to what each person or group decides is useful to them and using whatever means of determining this they find acceptable (Grayling *et al.* 2005).

This approach effectively leads to epistemological anarchy and relativism, though. Although such an approach is potentially able to demonstrate pragmatic usefulness in narrow examples, it is unable to demonstrate reliable and useful pragmatic solutions that can address disparate groups and individuals facing the same situations. Further, such an approach does nothing to help with making useful predictions about the future or planning how things reliably *should* be approached, because any method is deemed acceptable and epistemologically equivalent and any viewpoint on utility equally valid. This is, in fact, the approach taken by many pluralistic approaches to interdisciplinarity, and these have similarly demonstrated a consistent lack of reliability, consistency, or actual usefulness in practice due to this self-identified and relativistic approach to evidence.

In this thesis I do not regard these views as good examples of the notion of pragmatism, but as extreme ideas which serve to demonstrate that usefulness/utility alone is not a *sufficient* definition of pragmatism. Rather, that a criteria for reliability and/or an active attempt to reduce underdetermination is also essential. This is indeed the most common application of pragmatism, but the dependency on reliability as well as utility is not always clearly articulated. In the chapters to come there I have made an effort to consider alternative theories and evidence in order to directly address underdetermination (more will be said on this is in next chapter on Methodology).

To re-iterate, underdetermination is the principle that in all cases there may be an equal or better theory to fit the same evidence. Although the term underdetermination is typically associated with W.VO. Quine in the 20th century, John Stuart Mill offered a good synopsis of the concept in his *A System of Logic*

> "...this evidence I can not regard as conclusive, because we can not have, in the case of such an hypothesis, the assurance that if the hypothesis be false it must lead to results at variance with the true facts. Most thinkers of any degree of sobriety allow, that an hypothesis such as this is not to be received as probably true because it accounts for all the known phenomena, since this is a condition sometimes fulfilled tolerably well by two conflicting hypotheses...while there are probably a thousand more which are equally possible, but which, for want of anything analogous in our experience, our minds are unfitted to conceive" (Mill 1882: 617).

As noted, I distinguish here between justified and unjustified underdetermination, in order to differentiate between underdetermination that we must epistemologically acknowledge as the background of all claims, and underdetermination that does not incorporate all available resources and which should prompt us to look for better answers. Underdetermination must also be carefully distinguished from relativism. The former only suggests that there may be other theories which could explain the same evidence better or equally well, while the latter suggests that we have no reliable way to distinguish between which are better or worse among these.

The concern with underdetermination is often rephrased in a more positive manner to say that the goal of pragmatism is to determine the *best* solution. 'Best' or 'better' in the case of this thesis should be taken as the approach to defining interdisciplinarity (and disciplinarity) which is *more* applicable to a wider range of HE environments and students, is *more* likely to be implementable in a practical manner, and which *more* reliably backed by well-formed empirical evidence.

This is in contrast to the bulk of HTRoI approaches to interdisciplinarity, which consistently lack evidence of being a reliably preferable solution, rather than simply *a* solution. The methods used to explain and develop interdisciplinarity in the HTRoI tradition should not be viewed as incorrect from a pragmatic standpoint though *because* they are often built from unreliable types of evidence and reasoning, but because they consistently lead to conclusions that are demonstrably ineffective as a result of this. The fact that the sources of evidence in HTRoI are typically unreliable *explains* why they are pragmatically unacceptable, but they are not the *reason* that they are.

A few other terms are essential to understanding pragmatism: transcendentalism and foundationalism. These refer to categories of philosophical theories, rather than individual theories themselves. Transcendental or foundational theories are those which claim to rely on some form of certain or irrefutable base knowledge, specifically knowledge that is either foundational to or that transcends empirical knowledge. Foundationalism is most often associated with positivism, which holds that we can have real and certain knowledge of the world around us via 'analytic' truths of logic or reason alone.[23] Transcendental theories refer to the experience of subjective truths which exceed or 'transcend' what we can empirically study, and which presumably cannot be denied.[24] This is most often associated with the philosophy of Emmanuel Kant, but also more recently with the transcendental phenomenology of Edmund Husserl and with various forms of postmodern relativism.[25] The key similarity between foundationalism and transcendentalism is that both seek to establish a form of *absolute* knowledge from which all other knowledge can build, and which itself cannot be refuted.

[23] The most common example of this is the 'possible worlds' model, which regards something as an absolute logical truth if we can reason that it must be true in all possible theoretical worlds that we could imagine (Menzel 2013).

[24] Kant's example of this was that space and time could only be known subjectively, not as a definitely real thing beyond ourselves, but also could not be denied as an empirical reality of our subjective experience in which case it must be transcendentally certain, not empirically so (Kant 2012). Husserl's example from Phenomenology was that our perception of an object is only certain to us at any time from one perspective as our own experience of it, but transcendentally we must know that the object is 'real' to us in our experience of it whether or not it is 'real' in other ways (Zahavi 2003: 116–119).

[25] "This assumption has been questioned by phenomenologists. They have criticized the suggestion that science can provide us with a description from a view from nowhere as if science simply mirrors the way in which pre-existing and mind independent nature classifies itself. They have argued that a view from nowhere is unattainable, just as they would deny that it is possible to look at our experiences sideways on to see whether they match with reality. This is so, not because such views are incredibly hard to reach, but because the very idea of such views is nonsensical" (Zahavi 2010: 6).

One of the most controversial propositions of pragmatism is the stance that there is no justified or reliable means of proving *any* knowledge in an absolute sense, and further that by all reasonable accounts there *never can be*. This means that according to pragmatism it serves no useful purpose to investigate the deeper questions of metaphysics or ontology from a purely philosophical standpoint: these are useless questions to which there can be no reliable answer. *Pragmatism rejects all foundational and transcendental philosophy as incoherent and underdetermined.*

Rather than being nihilistic though, pragmatism is effectively a 'middle way' epistemology which simultaneously refutes as underdetermined and yet also utilises as essential three other common epistemological standpoints, playing them against each other to develop a different approach:

- **Scepticism**: the belief that we cannot reliably have any knowledge of the world
- **Positivism**: the belief that we can have certain/absolute knowledge about the world
- **Relativism**: the belief that we cannot adequately distinguish between better or worse knowledge of the world

I refer to these as the 'three foils' of pragmatism, as together they work to foil foundational and transcendental claims and create a balanced centre. In place of any of these absolute claims, pragmatism focuses on developing knowledge by whether or not a theory makes *effective* statements: 'does it work?' and 'can this be demonstrated?'[26] Understanding how pragmatism approaches each of the 'three foils' will help to position pragmatism, as well as other epistemological models, in relation to different models of disciplinarity and interdisciplinarity.

Scepticism, Positivism & Relativism

One philosophical problem which all approaches to knowledge must face is how to answer the sceptical dilemma, the philosophical stance that because any proof of knowledge can still be questioned, we therefore cannot have any reliable knowledge at all. This problem was first set down strongly by David Hume, and much of Western philosophy since this has been focused on answering Hume's formidable arguments (Hume 2010, pt. 1.4). Actual scepticism is, however, as Noam Chomsky has succinctly noted, not possible in actual people (Chomsky 2013). It is not clear that any human actually could deny all

[26] This aspect of epistemology is sometimes called Reliablism, the standpoint that a value cannot ever be 'true' but can only be more or less reliable.

knowledge and still be conscious. Rather, it is a philosophical tool which can be used to test theories against (can the theory explain how we appear to have knowledge?). In this sense it is important to consider, even if it is practically impossible. In a general sense, pragmatism embraces scepticism without allowing it to encompass and dissolve knowledge, by suggesting that it is as much a problem to refute scepticism as it was to accept it entirely: that the practical impossibility of *both* certain knowledge and no knowledge is the solution.

This balanced view of scepticism forms the core pragmatic refutation of the objective certainty of positivism, the stance that we can have certain knowledge of some things. If we must accept that in principle we can never absolutely prove anything, then positivism makes no sense. This includes all forms of transcendental and foundational philosophy and ultimately the entire field of metaphysics/ontology as terminally underdetermined or incoherent. Various pragmatists have promoted this aspect to different degrees, but in each case, save C.S. Pierce, this has been the fundamental defining feature of pragmatism: transcendental or foundational philosophy and the concept of irrefutable certainty of any kind, is not considered a useful or valid pursuit. In this sense pragmatism is both epistemology and ontology combined, by denying the project of ontological discussion outside of experiential, demonstrable knowledge.

This leaves relativism to contend with. Self-proclaimed pragmatist Richard Rorty has defined relativism as, "...the view that every belief on a certain topic, or perhaps on *any* topic, is as good as every other" (Rorty 1980: 727). He then dismissed the concept with, "No one holds this view. Except for the occasional cooperative freshman, one cannot find anybody who says that two incompatible opinions on an important topic are equally good" (Rorty 1980: 727).

This is a narrow concept of relativism, however, which is often cast as something of a 'straw man' accusation towards postmodernists: that they stand for nothing by trying to stand for everything at once. Relativism can be approached another way though, via social constructivism. This is the doctrine that meaning and/or truth are constructed by the society or individual (or discipline) in question, such that two different societies, individuals or disciplines could genuinely have two equally valid *functional or useful* truths or realities. This doctrine is typically not contentious to any epistemologies except positivistic ones. Pragmatism is itself a social constructivist epistemology, as are most (perhaps all) forms of postmodernism. Relativism is merely a conflation of two uses of the concept 'truth', the social and the epistemological. Few pragmatists would contend that what one society or

individual *believes* is true and *acts on* as true is relative to their own history and circumstances, but that this is not the same as the truth that can be *demonstrated* if two societies come together and attempt to resolve which truth is more correct. Regardless of one's ontological stance, one truth, most often a fusion of the original two, will in practice be preferred.[27]

Much of the RoIR literature on actual interdisciplinary research teams consistently shows the same process in action (Lyall and Tait 2001; Bruce *et al.* 2004; Griffin *et al.* 2006). While two disciplines will have their own approach to what is valid evidence and interpretation based on the nature of their subject and the history of the discipline, if they are brought together on a (successful) interdisciplinary project a single best approach to evidence and interpretation must be negotiated in order to produce an integrated result. Thompson-Klein has referred to this concept as interdisciplinary 'bridge building', and the fusion of concepts involved forms a core rationale for communication skills as a fundamental feature of interdisciplinarity (Thompson-Klein 1996).

Pragmatism Naturalised: Science and the Two Cultures

Pragmatism as defined solely by 'usefulness' does not specify the *means* of acquiring or testing knowledge; in principle it allows that any culturally preferred means are sufficient so long as these do not rely on things which cannot be demonstrated in some way. In most cases, however, save for Rorty, this is explicitly or implicitly taken to be some sort of empirical method, as we saw in Kimball's list. The pragmatist who made the most explicit analysis of this was W.V.O. Quine. Under the title 'naturalised epistemology' Quine argued that the only acceptable pragmatic means for demonstrating good knowledge is natural science.

Naturalised epistemology takes pragmatism's denial of foundationalism and transcendentalism a step further by stating that epistemology should not be viewed as a philosophical project at all, but as an aspect of Psychology (and Sociology), and that the rest of human understanding is equally within the realm of the sciences (Quine 1981: 72).

[27] There is considerable research on this process in the anthropological study of syncretism, the blending of belief systems, as well as on the blending of linguistic systems to form amalgamated creole and pidgin languages to facilitate cross-communication (Baerman 2005). In syncretism the amalgamated belief system that 'works best' in the new situation will eventually win out, and if the old truth does not hold up to new information it will eventually disappear, though typically as a partial and piecemeal fusion, not a replacement. This process is not isolated to religious beliefs and languages though, Kuhn's model of paradigms is perhaps the best known ethnography of this process in a scientific research context (Kuhn 1996).

In Quine's words, "[There is] no first philosophy prior to natural science" (Quine 1981: 67). This step pushes pragmatism past being only a concept of what good knowledge is or can be (what is useful), and into a normative model of how good knowledge *should* be produced, governed by the scientific method.[28] What this approach to knowledge means for interdisciplinarity cannot be overstated, as it suggest a solution to the 'two cultures' problem.

The perception of a valid epistemological or methodological difference between various disciplines is a cornerstone of essentialist approaches to interdisciplinarity. But there is not much evidence offered in the literature to justify such a claim. The arguments almost universally rest on rhetorical and tacit presumptions of the 'two cultures' divide.

Gadamer's assertion that the 'methods proper to science' cannot resolve matters in the humanities demonstrates a common presumption in the literature. Historically though, the scientific method was developed as a means to foreground irrevocable uncertainty and human error, and to develop a system to promote reliability of interpretation given these premises, rather than the opposite. "For even those schools of philosophy which held the absolute impossibility of knowing anything [scepticism] were not inferior to those which took upon them to pronounce [positivism]" (Bacon 1902). The Positivism of the 18th – early 20th centuries, which has been a target of much postmodern resistance to 'scientism', was historically a backlash *against* the scientific method and its denial of absolute knowledge (Talbot 2010: 16).

In a recent study of interdisciplinarity between the Political and Biological Sciences, Justin Greaves and Wyn Grant proposed that there should be no strong perception of epistemological distinction between the subjects:

> "We advocate a move away from the traditional 'ontology, epistemology, methodology' framework towards a more philosophical notion of 'justified belief'. A shared understanding of what this entails across the disciplines could be the ultimate goal in allowing truly interdisciplinary research to succeed" (Greaves and Grant 2010: 325).

[28] It is worth noting that naturalized epistemology was developed as a realist ontology, with the presumption that the objective world does exist independent of our observations. Quine did not consider this an analytic or foundational certainty, but a pragmatically derived assumption because the realist view works best empirically (Gibson 1988: 44). This assumption is not strictly necessary though, and it is more in keeping with the rest of the pragmatic tradition not to presume realism, only the functional appearance of Realism. As we will see more in the next chapter, this allows naturalised pragmatism to support many aspects of sociocultural models of disciplinarity and interdisciplinarity, provided these are empirically derived.

Greaves and Grant noted that the 'two cultures' divide was a common assumption of participants in their study, taking the form that the natural sciences use experiments, while the social sciences use observational methods (Greaves and Grant 2010: 326). Theyfound though, that the first thing their Political Studies participants learned on actually working with Biologists was that what was meant by 'an experiment' was much more broad and flexible than they had expected. In fact, much of what political scientists were doing appeared to fit into what the natural sciences considered a valid experiment (Greaves and Grant 2010: 327).[30]

The core notions of the scientific method and the reasons for creating it were straightforward. Francis Bacon identified in 1620 what he called 'idols', which were aspects of the human condition that prevented clear and reliable knowledge from happening. Some were external, coming from prior knowledge. These were, according to Bacon, difficult to eliminate, but they could be with effort. Some, however, were intellectual, aspects of the flawed human mind and perception itself, and these could never be entirely removed:

> "For let men please themselves as they will in admiring and almost adoring the human mind, this is certain: that as an uneven mirror distorts the rays of objects according to its own figure and section, so the mind, when it receives impressions of objects through the sense, cannot be trusted to report them truly, but in forming its notions mixes up its own nature with the nature of things" (Bacon 1902).

Bacon listed 128 aphorisms describing these distortions, which were mostly a list of what we now recognise as cognitive biases, logical fallacies and postmodern uncertainty. He specified for example, that language was insufficient to make meaning entirely clear, that prior knowledge cannot be prevented from effecting observation and interpretation, or that a theory once made causes other observations to conform to it (Bacon 1988).

[30] There are two caveats to use of Greaves and Grant's study. The scope of their discussion does not extend to 'hard' sciences such as Physics or Chemistry, applied fields such as Engineering or Medicine, the humanities or the fine arts, so we may commit an *individualistic fallacy* (presuming that a specific case speaks for a more general class of things) if this is extended without seeking more evidence. Further, it is not clear that the distinction between epistemology and 'justified belief' is coherent. The study of epistemology *is* the study of 'justified belief' or 'justified true belief', which is taken to be the best description of what it means to 'know' something (Steup 2005; Truncellito n.d.). For something to qualify as knowledge for epistemologists it must: be something that a person believes is true in some way; there must be some justification for this belief such as evidence, logic, scripture, etc.; the justified belief must be 'true'. Most of the discussion within epistemology centres around the specific meaning and context of these conditions, whether one is more important, and whether all three are always necessary.

To mitigate (not eliminate) these idols Bacon called for a new approach to knowledge construction. There were four elements:

1. Knowledge must come first from sensory observation, not logic. Although prior knowledge in the form of idols could not be entirely removed, no *a priori* assumptions should be intentionally made,
2. Sensory observation was to be collected into 'natural histories', which were datasets from which theory could be developed,
3. Due to the idols, simple observation was unreliable so detailed experiments were required to limit the chances for error, "a kind of experiments much subtler and simpler than those which occur accidentally" (Bacon 1902).
4. Even experiments by one person were far too prone to the idols, so the process needed to be recorded in detail and checked by others, "Moreover, whenever I come to a new experiment of any subtlety (though it be in my own opinion certain and approved), I nevertheless subjoin a clear account of the manner in which I made it, that men, knowing exactly how each point was made out, may see whether there be any error…" (Bacon 1902).

These established the modern academic practices of methodological description and peer-review, practices which were put into wider academic practice by the Royal Society in the later 17th century following Bacon's model (Talbot 2010: 13). The most important aspect of this for interdisciplinarity is that Bacon explicitly stated that it applied to the liberal arts as well, just as peer-review applies across all academic practice now (Bacon 1902). The scientific method was designed to apply to any and all scholarly pursuits, and did not recognise 'two cultures' or disciplinarity as a barrier. Not only did the scientific method precede 20th century criticisms of both positivistic and sceptical philosophies (though many of these have substantially refined or added to our understanding of Bacon's criticisms), it is inherently constructivist, and acknowledges intersubjective consensus via replication and peer-review as the only means to produce reliable knowledge. The scientific method is not a positivist epistemology.

As it regards the scientific methods as the best approach to knowledge, naturalised pragmatism also must not recognise the science/humanism divide. This simple understanding of the nature of the scientific method effectively eliminates one of the most substantial and often cited barriers to interdisciplinarity, and states that any definition or curriculum model for interdisciplinarity which relies on the existence of such a divide is demonstrably misleading and counterproductive- that is, *less useful*. Further, this may show a more practical and effective path for developing better mutual understanding

communication between disparate subjects: a shared core language of the scientific method.[31]

Holism, Reductionism and Interdisciplinarity as 'Greater than the Sum of Parts'

In the previous chapter we looked at one of the main 'betterness' claims for interdisciplinarity, that it produces 'indivisible' solutions which are greater than the sum of their parts, and cannot be reduced to mere collections of disciplinary inputs (Newell 2001; Thompson-Klein 2004; Boix-Mansilla and Duraising 2007; Repko 2008). In pragmatic terms this should qualify as a good justification of the greater usefulness of interdisciplinarity (and in particular certain essentialists definitions of it), because the claim appears to address the problem of underdetermination by indicating why an interdisciplinary solution is the best solution. This is true, however, only if the concept of indivisibility or greater than the sum of parts holds up to scrutiny.

There appears to be some precedent within the pragmatic literature to support such a claim. Quine, in particular, took issue with the principle of reductionism, which he presumed to be a core aspect of positivistic claims of certainty of knowledge. Reductionism is the idea that the nature of things can be understood by taking any whole apart into constituent elements: reducing it. As an epistemological principle, reductionism says this should be infinitely possible, that we can eventually reduce all things to simpler explainable parts, and then by recombining these we can invariably explain the whole. At this purely theoretical level it is clearly a positivistic principle, though as with relativism, scepticism, and positivism, what is possible in theory and what is possible in practice are not the same thing.

Quine's response to reductionism was what he called holism. "[Holism] says that scientific statements are not separately vulnerable to adverse observations, because it is only jointly as a theory that they imply their observable consequences" (Quine 1969: 313). Quine's argument for this is supported by the claim that due to underdetermination *no* theory is susceptible to being refuted by refuting individual aspects of it because we can always

[31] Not in the sense of a uniform method, approach or interpretive model at the subject matter or disciplinary level, but in the sense that all academic knowledge is made so by adherence to the principleprinciples of critical awareness for achieving intersubjectively reliable knowledge. At the subject matter level it is clear that we cannot get the same type of information about the world from a quark and a medieval charter, nor should we use the same type of practice to study them, but at a hierarchically more abstracted level we can and should recognise the same method, and this means that at some level there should be a common source for understanding: a Rosetta Stone of interdisciplinarity.

change the truth value of another aspect to keep the theory alive. This is a dark side of the principle of underdetermination; it is applied to justify any theory as true because we can just keep changing the meaning of other parts of the theory. Epistemologist Karl Popper's simple answer was that this sort of *ad hoc* change demonstrates a non-theory, something that cannot be tested and therefore has no useful truth value in itself (Popper 1992: 81). I would describe this instead as demonstrating a new theory in each case, which must be tested again by new means. Contrary to Quine, the original theory *has* been effectively refuted by refuting a part of it because *that* theory was a sum of *all* of its parts: removing or changing one changes the theory.[32]

The example that Quine gives is the theory 'water boils at 212 degrees'. If we test this and find that the water boils at 214, we have not, according to Quine, refuted the theory because the water may not be pure, the altitude may be wrong or the equipment may be faulty, rather than of the statement 'water boils at 212 degrees' being incorrect. Popper stated that these conditions become *ad hoc* extensions to the theory, and that although a small number of these do not make a theory unusable, more than a few make it impossible for a theory to ever be wrong, and therefore it explains nothing because it could explain anything. I would say that the original theory has been effectively refuted, it said 'water boils at 212 degrees': end of story. Clearly that was not the end of the story; that theory was wrong. A new theory which is more nuanced may be more correct. Quine's attempt to refute reductionism has only led to the paradox that no theory can be validated and no theory can be falsified.

This offers solid epistemological grounds on which to deny claims of irreducible complexity of interdisciplinary projects, or that interdisciplinary solutions cannot be reduced to the sum of their parts, thereby weakening another essentialist approach to interdisciplinarity. By failing to support holism, reductionism remains a valid theoretical model for approaching interdisciplinarity. While it is true to say that interdisciplinarity is not *merely* the collection of disciplinary inputs, we can attempt to carefully and empirically reduce interdisciplinary operations to filter what part is not accounted for by the disciplines functioning independently, and this should help identify what actually makes up

[32] I propose that reductionism be considered as a fourth theoretical foil of pragmatism (along with scepticism, positivism and relativism); another thought-experiment tool to ensure that theories do not over-reach themselves and approach foundationalism or transcendentalism. Holism then becomes merely a practically expedient concept, not foundational reality. That is to say it is certainly impractical in normal circumstances to reduce an interdisciplinary solution to its constituent elements, but there is no foundational basis for suggesting that we *cannot* do so.

interdisciplinarity itself. Much of the RoIR literature suggests that the unaccounted for parts may be time and the contribution of integrative skills (Griffin *et al.* 2006; Capper 2009). These are by definition something additional. An interdisciplinary solution may produce a greater *understanding* than a multi-disciplinary or disciplinary solution, but it is not greater than the sum of its parts, it simply contains extra parts.

Limitations of Naturalised Pragmatism

One of the main arguments against naturalised pragmatism is that it is itself underdetermined, in the sense that that we cannot ever achieve a 'view from nowhere' or actual status as an outside observer of science, and therefore we cannot verify science as the best of all methods except by using science to verify itself. The argument states, quite rightly, that our observations are always relative to our situation and therefore circularly underdetermined unless we can refer to a transcendental or foundational source of knowledge. The answer from pragmatism is simple: *this sort of underdetermination is preferable in any case where the only option is foundationalism or transcendentalism, because these are even more underdetermined.*

Quine invokes the analogy of 'Neurath's boat', "I see philosophy and science as in the same boat – a boat which…we can rebuild only at sea while staying afloat in it. There is no external vantage point, no first philosophy" (Quine 1951: 126-7 cited in Gibson 1988: 24). The tools in the boat are not perfect, but we have no better. If a better tool appears, we should use it, but wishing after tools not in the boat will not fix it. This is the distinction between justified and unjustified underdetermination. Natural science is considered a justified underdetermination, because there are no *more* effective tools available.[33] Many of the theories of interdisciplinarity in the literature, however, such as historically-based and interview-based definitions, are unjustified underdeterminations because there are many more tools in the boat which are better and are not being used.

Summary

As a theoretical framework for this thesis, pragmatism states that the conditions for answering the research questions are that they be shown to be useful or effective, based on reliable sources, and that some attempt be made to show how they might be more so than other solutions. Notably the demonstration of usefulness in this case can only be approached in a comparative or hypothetical manner, because the model that would need to

[33] Most pragmatists do acknowledge that a better system than science could be possible, or at least that we must allow for this possibility.

ultimately be tested *is* the outcome of the thesis. As such, the focus here will be to build the definitions and curriculum models for interdisciplinarity from strong empirical evidence, to attempt to demonstrate the comparatively less effective status of other approaches, and to demonstrate that the solutions offered *can* be useful or effective by triangulating them with the interviews of practice in Medieval Studies.

In terms of interdisciplinarity itself, pragmatism undermines the validity of epistemologically founded essentialist definitions such as the 'two cultures' by denying the possibility of a positivist basis for the sciences in one hand, and in the other denying a relativist basis for the humanities and social sciences. Taking this further, naturalised pragmatism adopts the scientific method as the foundation of all useful understanding or development of good knowledge. A historical review of the original meanings of the scientific method reveal it to be more postmodern than positivistic, and as Greaves and Grant have found, it is applicable over a much wider range of subjects than typically presumed. The scientific method, as both constructivist and empirical, underpins all academic practice, and offers a possibility for a unifying language for interdisciplinarity.

Finally, the principle of holism and the claim of interdisciplinary as 'greater than the sum of parts' was evaluated and found lacking. Nothing is 'greater than the sum of parts', some parts are simply not obvious or are hard to isolate. Holism fails to justify how anything can be irreducible, as interdisciplinary outcomes are often claimed to be in the HTRoI tradition. This opens an epistemological basis for attempting to isolate what interdisciplinarity actually is by 'factoring out' the disciplinary aspects and looking for what remains.

Chapter 3: Methodology

Introduction

As was briefly mentioned in the introduction, this thesis has evolved significantly to where the final project only resembles the original proposal in that both pertain to interdisciplinarity in the curriculum in some way. This came about when doing the background reading on interdisciplinarity for the original proposed thesis on developing interdisciplinary curricula for undergraduate Medieval Studies. Initially I had expected to critically review a selection of the most well-received literature on interdisciplinary learning and teaching, and to choose the model or approach that was most convincing to base an analysis of interviews with medievalists around. The interviews were then to be my chief, and in fact only, data source, with the majority of the thesis devoted to deep analysis of these. The interview questions were initially designed to be broad and rich enough to allow for this level of analysis. At that stage I had no more than a passing interest in psychological research on matters relating to interdisciplinarity.

The outcomes of the literature review of interdisciplinarity, however, led to what I felt was a necessary change of the focus of the thesis. I was struck at first by two accounts of the nature of interdisciplinarity, the empirical cognitive analysis of Svetlana Nikitina (2005), and the psychology of expertise account of Rainer Bromme (2000). I presumed that I had located an empirical foundation of interdisciplinarity to use for my research. Unfortunately neither article provided a rich or complete approach to interdisciplinarity in itself, and further I had concerns with some of the sources of evidence in parts of each. Searching for more development of either of these approaches only led to the increasingly strong conclusion that these were isolated and atypical examples of good pragmatic approaches to the subject. Neither article has been substantially referred to or developed since. Instead I encountered ever more rhetorical and ill-evidenced accounts of interdisciplinarity, along with the aforementioned surprising lack of engagement with learning and teaching research. I realised at this point that my thesis needed to change directions and look at interdisciplinarity directly if I ever hoped to be able to come back to my original research questions about Medieval Studies with a pragmatically well justified and useful concept of what interdisciplinarity was and how it might work in the curriculum.

Throughout my literature review on interdisciplinarity, concepts such as expertise, collaboration, knowledge transfer, academic qualifications, and categorisation appeared

intermittently but frequently, and there was certainly a lot of discussion of disciplinarity as well. There seemed to be, however, a substantial disconnect between the colloquial, tacit understandings of these as they appeared in the RoI literature, and engagement with empirical research on these topics in a critical manner, which did not appear in the literature. Consistently, though often implicitly, these topics appear in the literature on interdisciplinarity (and disciplinarity) with a tacit presumption of the self-evident nature of particular views on them, such as:

- That humans do or do not naturally need to categorise knowledge in certain ways (Weingart 2000; Thompson-Klein 2004; Taylor 2009; Nicolescu 2012; Barrett 2012).
- That disciplines relate in some way to 'expertise' (Biglan 1973a; Newell and Green, W. 1982; Trowler *et al.* 2012).
- That knowledge either can or cannot be transferred between areas (Thompson-Klein 1996; Moran 2010; Newell 2010).
- That disciplinary categorisation is a product of and/or producer of academic social identity (Becher 1989; Anderson and Hounsell 2007; Bamber 2012b; Trowler 2012b).

Consistent with the pragmatic goals of promoting utility and avoiding underdetermination, closing these gaps in the literature to define and implement interdisciplinarity in a more consistent, reliable, and useful way is the chief concern of this thesis. My hypothesis was that if a concept was fundamental enough to be discussed consistently as a justification for how interdisciplinarity works, then there may already be a research community dedicated to that subject, one which was not being engaged with but which may provide more definitive evidence for one theory over another. In the case of each topic listed above, this is indeed the case. There have been thriving communities of research in each field, mostly under the broad umbrella of empirical psychology, for at least several decades. When I became aware of this, the core focus of my thesis shifted to examining these fields for what they might say in reliable and empirical ways about interdisciplinarity.

After this change in focus I considered the value of the planned interviews and decided that they still represented a very important and useful pragmatic source of evidence, though they could no longer be considered the main source of evidence for the thesis. The focus on a single field was too narrow and the experience of the participants could not be assumed to be generalizable. The goal of the interviews became then to test the theories

developed from the other sources against the practical wisdom of the participants in terms of learning and teaching within medieval studies.

As the previous chapter has elaborated, the 'theoretical framework' that I have worked in for this thesis is that of pragmatism, as ontology, epistemology and methodological superstructure.[34] I have not selected pragmatism because I feel it is the best framework for understanding this area of research, or because it best highlights the elements of interdisciplinarity I wish to examine. I have selected it because I feel that it is the most demonstrably effective approach for *any* academic work, in any field. The naturalised pragmatic criteria for whether my methodology is justified lie in whether or not the solutions to my research questions (definitions of interdisciplinarity and disciplinarity, and my recommendations of curricula for developing the former):

- Are (or at this stage appear to be) useful and effective,
- Are well demonstrated as such in a critical manner, and
- Do not appear to be unjustifiably underdetermined.

The last point means that as part of my methodology it is necessary to examine proposed counter-evidence or counter-theories. In the chapters to come there will be attention paid to whether alternate approaches to the evidence presented are or are not well justified (as much as space permits, in all cases there could be more of this done, however).

Literature Reviews: Secondary Data as Primary Source

The main data source for this thesis is a critical secondary analysis of the empirical findings on disciplinarity, expertise, knowledge transfer, academic qualifications, collaborative cognition, and categorisation. To do original primary data collection in each of these fields would clearly exceed the scope of a single thesis, and would still require a literature review of each subject as well. Furthermore it would require a level of expertise in each of these fields that exceeds my own. My intention is not to supersede the importance of doing further primary research in these fields which is more specifically focused on interdisciplinarity, but to highlight unexplored potential of connections between these fields and to develop the links that future primary work could address. This said, the reviews here are focused on revealing reliable empirical studies which can relate to

[34] This is considering 'theoretical framework' as broad notion of the ontology, epistemology and methodology of a research project, not as it is sometimes regarded as a much more specific social-theoretical model to based data analysis on.

interdisciplinarity. The following three chapters (4, 5, 6) are therefore regarded as the *primary* sources of evidence in this thesis, even though the data itself is secondary in relation to interdisciplinarity (i.e. it was not gathered with the intent to define or test interdisciplinarity).

In addition to developing a notion of interdisciplinarity which is empirically founded, and therefore more reliably useful in practice, a pragmatic approach necessitates that we attempt to minimalise the underdetermination of any conclusions we make. For this reason it is important to search for and consider any alternate theories or opposition to the evidence, rather than merely compiling ever more examples of successful experiments or trials (presuming there are at least a few of these, of course). It is essential to demonstrate that reasonable attempts have been made to see if other theories work better or just as well as the ones offered as 'better' or 'best'. This has been one of the most substantial failings of both pluralistic and competency based interdisciplinarity.

As such, I have made some effort to find models or theories which appear oppositional to the mainstream research in the chapters that follow, and consider how strong these arguments may be. As before when regarding interdisciplinarity theories, I will refrain from selecting oppositional views which are very old or which do not appear to have any significant support. Not all of the topics in the next few chapters have prominent examples of oppositional theories. For example, in expertise research there are definitely divergent strands of theory, however, in categorisation research much of what might be seen as oppositional is more commonly viewed as supplementary within the field.

Method

Each of the literature reviews that follow was begun by first locating more than one existing recent literature review or subject overview by established experts in the field.[36] This was in order to become familiar with the main themes and players, identify points of open debate and contention (between theories and also between literature reviews), to get an initial grasp of the level of intra-subject language and complexity, and to identify the first set of empirical studies to review in more detail. In some cases this was relatively straightforward, such as expertise research. Here there are several recent and thorough literature reviews which largely agree, major theories and players were easy to identify,

[36] In fact, merely those who appeared to be experts as I could not make an informed judgement about such things until after reviewing the literature.

and the technical language of the field was clear and easy to acquire given my background in psychology.

By contrast the study of knowledge transfer was more disjointed. There was no clearly coherent research community, therefore good literature reviews were difficult to find. Most sources here had to be discovered through connections to research in other areas. Conversely, categorisation research has many thorough literature reviews, but the intra-subject technical language is relatively daunting, including a wide array of specialised terms and concepts which are often not clearly defined, as well as a considerable amount of probability mathematics and computer modelling. My background in computer programming was helpful, but deciphering the mathematics aspect of this field was difficult, and I admit that my understanding remains limited. It became clear, however, that this aspect was not critical as the maths would only be necessary in order to calculate similar categorisation probabilities, not for a deep understanding of the subject at a theoretical level.

Collaboration is very widely published over many subjects, making a single thorough literature review beyond the scope of this thesis. The review of research in this field was focused therefore on publications which appeared to tie in specifically with interdisciplinarity or disciplinarity, particularly in academic or academic-like settings, and which took a predominantly psychological and empirical perspective. I acknowledge that such an approach may exclude more distal oppositional models by pre-selecting research which appeared to be in line with the research I am doing. Some effort has been made within the time and space available to look outside of these limits to see if any such contradictions are apparent, but a more extensive search would not be unwelcome.

The secondary data reviews encompass the next three chapters (4, 5, and 6).The first of these chapters is a literature review of the research on the nature of disciplinarity in the same format as the review of interdisciplinarity, by identifying groupings or trends in the research and considering the most influential standpoints on the topic in terms of evidence provided. The next two chapters, on expertise and on categorisation, follow a different format. First I will review the foundations and evidence for the mainstream theories in each field. Then I will consider any significant opposition that appeared in my research. Finally, I will consider some of the connections that the subjects have to disciplinarity and interdisciplinarity. I will only scratch the surface of these connections at this stage, however, saving more detailed and holistic review for the discussion (chapter 8).

Limitations of Secondary Data as a Method

Using reviews of empirical literature as a research method is effectively utilising secondary data, something that is becoming increasingly common in research as more data is created and recorded for future use, but it is not without limits and caveats on its application (Smith 2008). The first obvious limitation of this method is that the original research was not directed at the research questions of this thesis. Connections must therefore be extrapolated/triangulated between the data and my research questions, which require an additional level of interpretation and abstraction. This could be done insufficiently or in error.

Next, I have not typically had access to complete original data sets or to all aspects of methodology used from start to finish. There may have been parts of the data trimmed off or there may have been statistical methods used to normalise the data which were not considered worth mentioning in the final report. Further, the data presented in most papers is aggregated, coded, and interpreted. Aspects of the raw data that were not germane to the research questions of the original authors, which were therefore cut from the reporting, may be critical to my own questions, but I would not know (Smith 2008).

It is in recognising these limitations that my approach has been to focus on the apparent reliability of the research as presented, and only then to determine the potential relation to interdisciplinarity, rather than to presume validity based on more superficial indicators such as citation ratings, author reputation or prestige of the source publication (Hart 1998). This deep critical approach to source reliability is one of the hallmark skills of historians, and my prior training in this field has been invaluable in this regard.

Further it is not possible in the space here to fully elaborate on the details and reliability of each study which is pertinent in the sections below. Although I will make a point to describe the studies and to refer to the results rather than the authors' analyses to some degree, I will only go into considerable detail on a few more instrumental studies.

Secondary Data and Competency Interdisciplinarity

Given the nature of this investigation and my criticisms of competency approaches to interdisciplinarity, it seems fitting to justify the choice of 'interdisciplinary' secondary data analysis as a chief methodology (lest this thesis appear hypocritical of its own conclusions). The justification lies in the amount of time invested in study of the relevant subjects; I have

more than surface-level prior training in each of the fields necessary to undertake this project. Further, the limits that different degrees of prior training place on how far one can take solitary 'interdisciplinary' work has been explicitly considered. This is effectively a question of the difference between interdisciplinarity and polymathery (if there is one), which is a matter that will be covered more in the discussion (chapter 8), after other evidence has been accrued. At this stage it is merely important to highlight the nature of my effective background in the relevant fields.

For my own credentials, I have trained as a medieval historian and interdisciplinary medieval researcher at the undergraduate and postgraduate level. Not only does this give me perspective as an entry-level insider for my interviews in the field, but historical research, especially medieval, develops the practice of critical source analysis as its chief methodological focus. My training in these fields also included substantial interdisciplinary work, in which this skill was focused explicitly on application across various disciplinary source types. Further, I am a mature student and have spent an equivalent of three or more years of full time study in undergraduate psychology prior to studying history.[37] This surely does not grant me the expertise to conduct primary research in this field at the doctorate level, but it does provide the necessary disciplinary enculturation to read and evaluate psychology-based research (Collins and Evans 2007). Where this background differs from competency models of interdisciplinarity is in both the amount of time spent in focused development of each skill as well as the explicit awareness of the limitations of practice that the relative levels of training engender. My advanced training in critical source evaluation and at least novitiate training in psychology provide the levels of expertise necessary to undertake this methodology. But without each of these backgrounds I would not feel justified in doing so, and I would not attempt to extend this to subjects I do not have this training in (e.g. chemistry, maths, or economics).

Interviews in Medieval Studies

In order to connect the broad empirical work across multiple fields covered in chapters 4 thru 6 to actual practice in an HE environment, the interviews which were once the core of the thesis serve now as an important corner of triangulation: connecting theory and practice and helping to demonstrate the utility that is so essential to a good pragmatic solution. Before addressing the methodology used to look at ideas of interdisciplinarity in Medieval

[37] I hold no formal degree in psychology largely due to the study being split over many institutions while serving in the military. Problems with transferring credits between institutions would have required re-taking nearly half of the courses in order to be accredited.

Studies though, it is important to establish what Medieval Studies entails. This involves considering briefly ‘what is medieval?’, as well as which disciplines/fields traditionally make up the field of Medieval Studies from which the interviews were conducted.

Defining the Medieval

What is or is not medieval is most often defined by a particular period and region: Europe and its near neighbours between roughly 500-1500AD, however, this simple definition is highly contentious in a number of ways, and is also not very useful for considering problems of research, learning and teaching, or disciplinarity. A recent collection by Celia Chazelle and Felice Lifshitz, *Paradigms & Methods in Early Medieval Studies*, does an excellent job of introducing what typically isolates the medieval period, and more importantly in what ways it is not isolated, in terms of research and methods (Chazelle and Lifshitz 2007). The defining factors are relative type, quantity and quality of sources compared to other places and times. The following is a synopsis of their account:

At the start of the medieval period we have the fall of Rome in much of Europe, and with it came a number of changes. Research sources of all types, textual, material and artistic became much more scarce. Writing appeared less and less in imperial Latin and more in ecclesiastical Latin or the emerging vernacular scripts. Christianity rapidly became the dominant faith and the church became the administrative power throughout much of the area. Feudalism(s) began to replace Roman systems of government. The focus of attention for researchers shifts then from Rome and Roman things to the 'barbarian' indigenous peoples.Critically though, the changes were uneven, and happened in different areas at different times, some barely ever having felt the influence of Rome to start with, and some never fully losing it.

Chazelle and Lifshitz were concerned chiefly with *early* medieval studies, but if we look to the approximate end of the period we see a similar set of changes in reverse. From the middle of the 15th century (the printing press) up through the end of the 16th (the Reformation), most of the previous unifying factors of medieval research are replaced with early modern institutions. The handwritten manuscript, which requires training in palaeography to make sense of, rapidly gives way to the printed word, and with this an increase in literacy changes the culture of textual transmission and use as well. Where the early medieval period was marked off by the hegemony of the Holy Roman church, the Reformation ends this. Feudalism(s) begin giving way to the rapid rise of modern nation-

states, an emerging strong middle class, and cities. But just as with the beginning of the period, so too at the end these changes were not at all uniform. The rise of humanism, the Reformation, the emergence of cities all took place at very different rates and in different ways in different areas of Europe. Some changed drastically long before others, such as the Dutch Republic, and some held out against such changes until very late, such as the Western Isles of Scotland.

What this hopefully makes clear is that medieval studies, while having a strongly unifying range of types of sources, scarcity of sources, cultural anachronism, focus of interest and methodological requirements for making interpretations from these, a definition of the area of study by dates or locations is almost meaningless. Late antique research and early medieval research in many cases overlap in both time and place for several hundred years, and the same can be said of late medieval and early modern. Moreover, as Chazelle and Lifshitz also point out, there are clear differences in types and amounts of sources even within the medieval period which separate the study of early medieval from late medieval, each using different goals and methods yet again. While this 'internal' divide is highly recognised and well supported, typically there is greater unity of goals and methods between the two than disunity.

Cognate Disciplines

Which disciplines make up medieval studies? History, Literature, Art History and Archaeology surely, but also commonly Law (as Jurisprudence), Religion, Music and Philosophy. In each of these cases, however, a different name can be applied, by first removing the unsignified common denominator, history, specifically medieval. 'History' as a separate study is a misnomer to include in this list; all of these studies are historical, each asking slightly different questions of the past, but often using the same sources. If we do this we can better express each of these disciplines as: Medieval text as Non-fiction, Medieval text as Fiction, Medieval Arts, Medieval Material Culture, Medieval Jurisprudence, Medieval Faith & Belief. Certainly within each of these there are a myriad possible specialisations, some of which have developed into disciplines of their own in some places. Expressed more mathematically the result can be shown as: Medieval (Fiction, Non-fiction, Material Culture, Arts, Law, Religion and Philosophy), which might further be reduced to Medieval (Culture and Society). A better way to say this might be Medieval Socio-Cultural Studies, so as to differentiate it from geology, botany and other fields of study which are not expressly concerned with human matters, but may look at

sources from the same period.[38] For practical purposes of timeframe and comparability, I chose to focus my interviews on the largest four of the disciplines above (History, Art History, Literature, Archaeology).

Limitations of Interviews as a Method

Pragmatically speaking, interviews with practitioners from a single field or small set of disciplines cannot be used, themselves, to define interdisciplinarity or to demonstrate a reliable effective approach to it. Such a subset of practice is insufficient to develop a model of interdisciplinarity that is not highly and very unjustifiably underdetermined. Although my interviews with medievalists could indeed produce a pragmatically valid model of interdisciplinarity and associated curricula specifically within Medieval Studies as practiced in Scotland, there is no reason to presume, and many reasons not to presume, that this cannot be generalised to a wider disciplinary or geographical audience.

As evidence the interviews are neither an unnecessary add-on to the thesis, nor are they a evidence which should be considered continuous and equivalent to secondary research reviews. Rather they are an essential pragmatic extension of the development of a model of interdisciplinarity into the realm of praxis within a specific field/discipline. The two sources of evidence, that of the synthesis of secondary data and that of the interviews, share a uni-directional connection; the empirical evidence from the literature reviews feeds directly into the analysis of the interviews in terms of developing practical and effective curricula of interdisciplinarity, but I do not believe that the interviews can justifiably feed *directly* back into developing a definition of interdisciplinarity due to the same misspecified identification of expertise problems present in Biglan's study of the disciplines: disciplinary experts who do interdisciplinary work cannot be assumed to be experts on interdisciplinarity in general. This represents a substantial departure from much of the current practice in much interdisciplinarity research (Lattuca 2001, 2004; Huutoniemi *et al.* 2012). The interview data can, in fact must, feed back into the development of a definition of interdisciplinarity in some sense though, but in a pragmatic framework it must only do so only *abductively* as hypothesis development, not as direct evidence of the nature of interdisciplinarity itself. This distinction is not merely sophistry, but is a critical aspect of the research design.

[38] Of course there is interplay between humans and both geology and botany though, but there is a linguistic barrier of mathematics and techniques of the natural sciences which likely stands in the way here for most medievalists, excepting perhaps archaeologists and possibly some art historians (concerned with plant and rock origins of dyes and pigments).

For example, rather than give primacy to the fact that the interview results suggest several different concepts of interdisciplinarity (which might suggest pluralism if viewed from a more relativistic framework), I take this to mean only that no consensus on the term exists in practice any more than in theory and that the question therefore does not lead *directly* to a useful pragmatic solution. Instead, I have compared the narrow set of interviews to the concepts of interdisciplinarity that have emerged from the broader reviews of expertise, categorisation, and disciplinarity to see if there is any correlation. Indeed, beneath the surface level of non-consensus definitions there is a clear pattern in the interviews, which is strikingly similar to the notions of interdisciplinarity that expertise and categorisation research suggest, and which are further triangulated by being very similar to the results of similar interviews made in the RoIR literature (Bruce *et al.* 2004; Griffin *et al.* 2006). In this way the framing and analysis of the interviews are approached to help reduce underdetermination and broaden overall utility of the solutions to the research questions, instead of enhancing underdetermination and narrowing utility as would be the case if they stood alone as a defining factor.

Method

I interviewed a number of academics who are active in some way with teaching or researching medieval topics at each of Scotland's four universities which offer postgraduate study and research in 'Medieval Studies'. These individuals ranged across a wide array of specialist topics of interest, and the entire range of the medieval period, from late antiquity (~300-500AD) through to late Renaissance (~1500-1600AD). An attempt was made to balance the number of participants evenly across each university, as well as to get equal representation from each of the chief cognate areas within Medieval Studies. Neither of these goals were perfectly achieved. Though the numbers across universities were roughly balanced, balancing the 'home' disciplines of the participants proved far more problematic. Aside from a simple lack of response from some individuals, it became apparent that the disciplines were not themselves balanced across the universities (for example one university featured several medieval-focused archaeologists, while another did not include medieval archaeology in its curriculum at all). Further complicating this issue was that many of the individuals interviewed were listed under a particular subject, but professed allegiance elsewhere or no preference at all. This was not unexpected. Indeed, this is the sort of finding I hoped to uncover. The criteria for balance was only intended as a starting point, and to reduce any intentional favouritism to a particular institution or discipline.

Within Scotland only four universities of the total 19 offer significant postgraduate study in Medieval Studies by that name, and only one currently offers undergraduate coursework also under this heading (Universities Scotland 2014). These four are Glasgow, St Andrews, Edinburgh and Aberdeen (the four 'ancient' universities of Scotland). These also represent four of the five research intensive universities of Scotland (the fifth being Dundee). Each is a member of the Russell Group.

Although focusing on these institutions is clearly limiting in the sense of a wider discussion of interdisciplinarity (and is part of the reason that this thesis has focused on other sources before the interviews), it is both necessary and sufficient for a discussion of potential and existing interdisciplinarity in undergraduate Medieval Studies, owing that other universities do not currently possess the staff or structure to address the issue. This is not to say they could not or should not at a later date, however.

The final demographics of the interviews were:

Female: 9	University of St Andrews: 6	History: 4
Male: 8	University of Aberdeen: 4	Art History: 3
	University of Edinburgh: 3	Archaeology: 3
	University of Glasgow: 4	Literature: 7

3.1 Interview Demographics

It is essential to note that the designation by subject here is only based on the subjects under which each participant was located or identified with *most*. When asked how they would identify themselves academically the responses were not so clear. Each of the art historians and archaeologists identified clearly with the subject, but often also indicated a strong degree of overlap with other disciplines. Of the historians and literary scholars only one clearly identified as only one of these, and this participant also identified as a 'medievalist'. Most of the historians and literary scholars instead identified as both history and literature concurrently, as having alternated between the two at different times, as medievalists, by what department they were employed by, or by the specialist focus of their primary research interests.

Drawing on critical reviews of survey methodology, I asked some questions which intentionally revisit questions already asked, but from a different perspective. This was

intended to illuminate consistencies and/or inconsistencies in the definition of interdisciplinarity and other elements. For example one question simply asked ‘define interdisciplinarity’ while a different question later asked ‘what do you think makes a good interdisciplinary researcher?’ I hypothesised that defining interdisciplinarity in isolation, and defining the traits of an interdisciplinary person separately might yield interesting comparative results.

The first question after introductions was immediately an open-ended ‘How would you define interdisciplinarity?’ This was carefully chosen as the first question; participants were not given any prior warning of the question, and there was no specification that it pertain to Medieval Studies only. My goal was to catch each person’s first impressions, without the influence of other questions, my reactions, or any opportunity to prepare from outside sources. Judging from the slightly overwhelmed reaction of several participants, this goal seems to have been successful.

The follow-up question ‘how would you define a discipline?’ was not given until several questions later in the hope that the intervening questions may offset any tendency to merely define a discipline as the opposite of the definition of interdisciplinarity just given. In general this appears to have been effective.

Ethical Considerations

The participant selection and structure of the interviews was approved by the University of Glasgow College of Social Sciences Graduate School ethics committee. In compliance with the anonymity clause of this approval, no participants have been named, nor have any quotes or comments been directly linked to individuals or institutions. This is much of the reason that results and analysis below includes many short quotes or paraphrases rather than detailed quotations. Because Medieval Studies in Scotland is a reasonable insular field it would be quite easy to identify particular participants or their institutions if any quotes which offer specific information about a programme, previous or on-going research or university structure.

Coding and Interpretation

My approach to coding has been largely a hybrid of many established methods, while also not expressly considering any one method to be well justified as superior or dominant. Loosely, my approach can be referred to as ‘thematic’ augmented by elements of Grounded Theory Method (GTM) as a secondary consideration.

Unlike GTM, I entered into my coding with a hypothesis already in mind (actually several), and with reviews of the literature in several related areas of study already conducted. The questions asked in the interviews were developed specifically to match the topics and emerging questions from the literature reviews in the previous chapters. My intent then was to establish codes based on this knowledge, and to look for comparative references in the interviews, both pro and con, in order to test the hypothesis *in one field* of academic practice. There are a wide array of thematic coding methods or approaches offered in the literature on the subject, however it seemed that these were more often than not arbitrary, specific to only very narrow types of interviews or studies, or not generally useful for broader applications. I developed instead my own approach which consisted of setting out each of the main themes that I was concerned with on a separate paper, and then copying each reference to that theme across all of the interviews to the page, with coded notations for where each originated.

These initial themes related to key terms and concepts which emerged in the initial literature review and the various literature reviews which formed the main dataset for the thesis: disciplinarity, expertise, knowledge transfer, categorisation, collaboration, skills, method, periodicity, truth, and subject matter. [39]

I then supplemented these codes with new themes as they emerged from patterns in the interviews themselves that were not covered by my original hypotheses, in a manner similar to GTM, though without the extensive iterative approach that this traditionally involves. Codes which emerged from the data involved additional factors in disciplinarity and interdisciplinarity, many particular to practice in Medieval Studies, such as administrative issues, geographic area of study, and vernacular languages. There was also an interesting and somewhat consistent trend of declining or preferring not to answer or not wishing to give a strong answer to certain questions, which I have coded for separately as well.

My existing expertise in medieval studies has been instrumental in coding, in that I am able to recognise relationships between concepts which may not be apparent to a novice or outside observer. Notably though, my expertise is not of the same level as those I have

[39] Recalling that I am regarding the previous chapter on epistemology as part of the overall analysis of interdisciplinarity. As such there were questions and coding based on concepts of truth, validity and evidence in terms of the disciplines.

interviewed, who have taught and published in the field for many years. Also my mid-level expertise has a potential downside as this may suggest connections to me based on my own experience of Medieval Studies, but which may be more nuanced to the more expert interviewee. Additionally, coding is invariably biased towards my own understanding of Medieval Studies.

Coding of the interview results was aided by the software package Nvivo10, though I have not made use of any extended features of the software. Coding was then visualised and structured via the mind-mapping software Freemind.

Difficulties Encountered

As part of the attempted to elicit personal views on interdisciplinarity, participants were not briefed in detail on the questions they would be asked. Some questions did not work well unprepared. Out of an interest to explore the perceived or empirical importance of 'good' interdisciplinarity, as well as something of the importance (or lack thereof) of Medieval Studies in the broader world, I asked participants whether they had experienced 'questionable' use of their home discipline by others in the name of interdisciplinarity, and whether they thought this could have impact outside of the academy. The question turned out to be frequently misunderstood or hard to explain, and when it was understood participants were clear that without time to think they could not answer effectively. Although I had hoped to develop a more nuanced empirical justification for the importance of good interdisciplinarity from this, and several answers given do indicate that this should be possible, the question will not be considered in detail here as answers were too inconsistent. This has highlighted for me the value of a pilot study, which did not seem feasibleinitially due to the small set of possible participants overall, and the perceived time that this would take. In retrospect, this could likely have been done.

One notable gap in the interviews was the lack of any counter-views, a view that opposed the notion of Medieval Studies or interdisciplinarity. This was not for lack of attempting to find such voices. Medieval researchers who were not at least somewhat involved in Medieval Studies were not readily identifiable. Further, when I did inquire for names of anyone who was vocal against interdisciplinarity or Medieval Studies very few were offered (or known), and none of these responded to my interview requests. Although I am aware that it is speculative, my impression from this search, as well as from the interviews themselves and my own previous experience in the field, is that such directly oppositional voices are few and far between. A sense that to study the medieval *effectively* in any

capacity necessitated some interaction with other disciplines, whatever this might be called, was consistent in the interviews. Notably, a lack of direct or pre-stated opposition to the project did not equate to a lack of sometimes strong scepticism about the terms or ideas of both Medieval Studies and interdisciplinarity.

Of the seventeen participants not all answered each question. A few did not reach the end due to time constraints. Also the first half of one interview was unfortunately lost due to an equipment problem. For each question I will indicate how many responses there were in the form of [N = X]. In some cases participants who were not asked a certain question answered something similar nonetheless.

Chapter 4: Disciplinarity

Introduction

> "Moreover, as disciplines become increasingly broken down into more highly specialisized sub-disciplines, so the very idea of the discipline itself becomes redundant. Indeed, there are those who argue that the very concept of the discipline is no longer meaningful" (Rowland 2006: 70).

> "However, as Krishnan (2009: 6) indicates, a central problem with the notion of interdisciplinarity is that people using it do not make explicit what they understand by the term 'discipline'..."(Trowler 2012a: 14).

In this chapter I will approach interdisciplinarity from the perhaps obvious starting point of asking 'what is a discipline?'. The same effort has been made in many other attempts to discuss interdisciplinarity, but there is an important distinction between most of what has been done before and what I will undertake here. In the HTRoI literature especially, but also in the other RoI traditions, discussions of what a discipline is do not typically engage with the several decades of existing research on the nature of the disciplines by educationalists, especially empirical studies. Some of the most recent ERoI literature is showing a change in this pattern, presumably because these are also coming from education researchers (Davies and Devlin 2010; Trowler 2012a, 2012b; Land 2012). In lieu of educational research, many accounts have relied uncritically on popular disciplinary metaphors and prevailing postmodern discourses of power structures, as well as many of the same circular and underdetermined methods used to define interdisciplinarity.[40] These methods lead to a surface level understanding of the disciplines which are another clear cause of the subsequent lack of consensus; if anything there is less agreement in the RoI literature on disciplinarity than interdisciplinarity. Delving into the nature of disciplinarity chiefly addresses the problem of disciplinary essentialism in the interdisciplinarity literature.

I am preceded in my critical review of disciplinarity by other recent efforts, which call into question several of the most popular and resilient essentialist metaphors: C.P. Snow's 'Two Cultures' (1959), Anthony Biglan's 'Hard/Soft, Pure/Applied, Life/Non-Life' categories (1973, also uses Snow's metaphor), and Anthony Becher's 'Tribes and

[40] There has been occasional use of educational researcher Anthony Becher's popular *Tribes and Territories:* ... (1989). This particular source likely appeals to HTRoI researchers because it is an ethnographic study of the disciplines, mirroring, though in a more rigorous manner, the historical and culturally focused methods of the HTRoI literature. Becher's work also lends itself well to Foucaultian analysis, though Becher did not take this approach himself.

Territories' (1989, also uses Biglan's metaphors). These are not the only metaphors for disciplinarity though, and in recent years more and more seem to be appearing, producing something of a 'metaphorapalooza' around the subject. A metaphor is a powerful thing to create, and as a great writer once said, "With great power there must also come - great responsibility" (Lee 1962). I will focus my attention away from creating useful metaphors then, and onto a deeper analysis of what meaning and evidence lie beneath the metaphors themselves.

The literature regarding disciplinarity is wide and varied, but like the literature on interdisciplinarity, there are patterns. At least two broad approaches might be proposed:

- Quantitative attempts to classify disciplines
- Sociocultural attempts to describe disciplinarity.

These rarely cross over or incorporate elements of the other, with the exception of the resilient metaphors above. In addition to these two main threads, there is also considerable input from recent debates over generic versus situated learning and teaching of critical skills. First I will look at the classifications efforts, which appeared first chronologically, and are also the source of the most prevalent essentialist metaphors. Next I will look at the more recent and more nuanced range of sociocultural approaches to the disciplines. In this section I will look critically at the legacy of Michele Foucault on the understanding of disciplinarity and I will revisit the 'two cultures' metaphor from the sociocultural perspective. I will then consider several newer trends in the understanding of disciplinarity which have emerged from the sociocultural research: the nature of 'evidence' according to the disciplines, what 'subject matter' means to disciplinarity, whether there are essential aspects of learning which supersede or are common to all disciplines. Lastly I will look at two compelling recent methodological approaches to researching disciplinarity: Ways of Thinking and Practicing (WTP) and Social Practice Theory (SPT). Throughout, I will focus on what empirical data and methods have been (or not been) brought to bear and how disciplinary insights may relate to interdisciplinarity.

Classification Models

Most of the early work in the 1960s and 70s on the nature of disciplinarity was focused on figuring out how the disciplines fit together into categories or classifications, which were

then described as essential features of what a discipline is. These efforts were heavily influenced by Thomas Kuhn's theory of paradigms in scientific research. As a result of this common origin, this approach shows a pronounced lean towards using the natural sciences as the base from which other fields are then considered. The line of progression from Kuhn to the prevailing classification models is clear, as Braxton and Hargens point out in their review of the classification approach (Braxton and Hargens 1996: 3).

Kuhn's model stated that in scientific practice different subject matters, question sets and epistemological/methodological traditions were historically clustered together into different communities of research which he called paradigms. Some paradigms had strong internal consensus and others less so (Kuhn 1996). Paradigms were only presented by Kuhn as a model of practice in the natural sciences. In 1964, however, W.O. Hagstrom introduced the notion of 'consensus' between academic studies, which was clearly built on Kuhn's paradigms but generalised to refer to all scholarly study. N.W. Storer in 1967 first coined the now ubiquitous classifications hard/soft and pure/applied, hard/soft being directly related to Kuhn's paradigms by Storer. Storer's work went unnoticed until 1973 when Anthony Biglan effectively launched the study of disciplinarity as a coherent practice by publishing a pair of statistical analyses of the disciplines; he applied Storer's classifications to the resulting patterns (along with a new dimension of life/nonlife). Since Biglan, attempts to classify the disciplines have shown a great deal of uniformity in use of statistical analysis (Biglan 1973b, 1973a).[41]

Biglan's notion of the hard/soft dimension was based on the degree of apparent consensus or paradigm that the discipline displayed internally. All of the natural sciences were considered exemplary of hard disciplines (hence the term, 'hard sciences') because they presumably had strong degrees of internal consensus around research questions, methods and results. Humanities disciplines were considered soft because there was presumably more internal debate and flexibility about methods, interpretation of results and research

[41] It should also be noted that the repeated use of statistical methods since Biglan may have aided in self-selecting for a bias towards the natural sciences, such that researchers knowledgeable in and inclined to use statistics over other methods may do so due to an already established personal bias towards 'scientific thinking' (Kolb 1981; Anderson and Hounsell 2007; Nye *et al.* 2011). Substantial empirical study would be needed to confirm this, but from the sources reviewed here the pattern holds up rather well. This trend has been noted by several other studies, but it is worth noting that even many of those have continued to approach the humanities and the social sciences as one large collective of 'non-science' disciplines, and it is common to see studies which use only disciplines from the social sciences to allegedly answer for both. For example, Lowell Hargens, (Hargens 1996) presents only Psychology, Sociology, Economics and Psych/Soc as his 'soft' dimension samples in a paper designed to test this very dimension for meaning and validity. Further, Hargens selects specific specialisation from these, each of which represents areas of study which more commonly lean towards quantitative analysis and 'scientific' methods already.

questions (Biglan 1973b: 201–2). The hard/soft dimension classified the disciplines exactly along C.P. Snow's 'Two Cultures'. The pure/applied dimension was assigned to disciplines based on the degree to which participants in Biglan's study felt the field was associated with practical applications (Biglan 1973b: 202). The concepts of hard/soft and pure/applied disciplines have remained very popular both implicitly and explicitly in the study of disciplinarity, and the effects of each and how this relates to interdisciplinarity, will be considered below.

Problems with the Biglan Model

Although Biglan's results for the hard/soft dimension have been confirmed in a number of studies for the disciplines he originally tested, the model has suffered from a considerable failure to be replicable, expandable or applicable to many 'real-world' situations or other disciplines. It nevertheless remains quite popular and resistant to obsolescence (Michels 2011). The impact of this resilience is that it invariably creates a foundational level of categorical essentialism about the disciplines, even though most work in recent decades has been decidedly sociocultural and often openly resists the notion of rigidity or essentialism in disciplinarity. This should seem familiar from the discussion of essentialism in the chapters above, but there is a subtle difference between this and the trouble with essentialism in the HTRoI literature. In the theoretical literature on interdisciplinarity, disciplinary essentialism exists as an explanatory necessity for certain explanations of interdisciplinarity to work. In the sociocultural literature on disciplinarity, the essentialism of the Biglan categories (and also the 'two cultures' and 'tribes and territories') appears to be based more on embedded tradition and the impression of strong quantitative verification.

A study of categorisation methods among tree experts (which will be examined in more detail in chapter 6) points out one of the chief problems with Biglan's study (Medin *et al.* 1997: 55). Biglan's method was to present cards of various disciplines to scholars in different fields and ask them to sort them into categories by which were more alike. Medin, *et al.*'s tree study used a very similar method, participants were to categorise note cards with tree names on them in increasing and decreasing complexity of groups. The tree study differed though in that each group of participants was already established as experts at categorising trees, just different types of experts at it (taxonomist, landscapers, and maintenance workers). In Biglan's case the participants were only experts in their respective fields, not experts in different types of categorising of academic study. Medin *et al.* also tested for familiarity first, and removed from the study trees which were not

recognised. Biglan did not account for disciplines that participants may have had no knowledge of at all. In terms of the tree study. Biglan's fault was in presuming that disciplinary specialists could be seen as specialists on disciplinarity. [42]

There are other problems with the interpretation of Biglan's results, such as that they do not account for cases of both hard and soft aspects within the same discipline (Roxa and Martensson 2009: 210). Further, although the statistical methods can accurately show *some* relationship between the model and the factors tested (such as staff pay levels, time spent teaching/researching, number of citations in articles, and other secondary aspects of academic life), most of these factors are contemporaneous with disciplinarity, and no causal relationship can be shown (Creswell and Bean 1981; Smart and Elton 1982; Stoecker 1993; Hargens 1996; Braxton *et al.* 1998). Regression analysis, as these studies invariably are, is not capable of demonstrating causality, it must be determined externally usually via qualitative or logical means.[43] Lastly, and perhaps most importantly, such a method does not determine whether there is, in fact, a larger causal factor which may be affecting both the discipline and the tested factors at once, which, if true, would mean that although the discipline and the test factors do vary uniformly, there may be no actual causal relationship between them at all. In short, the model shows there is a connection between disciplinarity and the factors tested, but it tells us very little about what that means or how it matters.

Additionally, much like the pluralistic classifications of interdisciplinarity, these methods are underdetermined; not able independently to answer the question of whether the underlying model is the *best* model to define or explain the differences between the disciplines, or whether a better model might exist which does more and works better, and which still passes the same tests (Hargens 1996: 2). There is evidence that it may indeed be insufficient, incomplete or improperly represented. Biglan's Life-Nonlife dimension, for example, has steadily fallen out of use.[44] Nevertheless, Braxton and Hargens say unequivocally, "We believe it likely that if Biglan's typology of disciplines had not been generally adopted by higher education researchers, an essentially equivalent classification

[42] A very similar methodological problem to HTRoI studies presuming disciplinarians could describe interdisciplinarity effectively.

[43] For example, if a relationship between gender and performance were shown, performance could not have caused gender, so the causal relationship must be the other direction. Because most of the factors tested in studies of the Biglan model do not have any empirically necessary causal relationship like this, one cannot be assumed. It is just as likely that disciplinarity causes the factors instead.

[44] Becher & Trowler outright refute its use, Braxton and Hargens simply do not mention it, and one major study which did find statistically significant results found that it represented only 4% of the total variation in disciplinarity (Becher and Trowler 2001: 35; Smart and Elton 1982: 222).

would have" (Braxton and Hargens 1996: 6). Effectively they are saying that the model is 'natural', and would have been found or developed by someone.[45] When making this claim Braxton and Hargens, and others, cite several tests of the Biglan model which have allegedly been successful in verifying it. This may not be as true as it seems though, in fact these studies demonstrate another critical failing of the Biglan model: it cannot be expanded.

One frequently cited example is Judith Stoecker (1993). Stoecker attempted to re-verify the Biglan dimensions against the disciplines he originally used, but also to apply the model to eight new disciplines. Stoecker was clear from the start that no one had successfully applied the Biglan dimensions to new disciplines yet, noting that the one strong claim to having done so was flawed because it could not have failed to classify any discipline (Stoecker 1993: 435; Braxton and Hargens 1996: 15). In Stoecker's analysis only one of the eight new disciplines was able to be categorised at all on the Biglan model, and that only barely. Stoecker suggested a number of reasons this may be, such as the relative newness of the disciplines and the corresponding lack of formal paradigms, but this is a flawed notion because the 'soft' dimension is defined as pre-paradigm status, so by this rationale all of the new disciplines should have manifested as 'soft' (Biglan 1973a: 195). What seems far more likely here is that Stoecker's study has demonstrated the Biglan model as incapable of incorporating new data. When this is coupled with the fact that the model makes no provision for any form of interdisciplinarity, disciplines which may use both hard and soft methods, or the fact that some disciplines in the original model are now divided into several new disciplines, each of which may classify differently, the Biglan model does not seem capable of describing actual practice much at all.

There is one notable exception to the pattern of Biglan-based classification studies, the ethnographic analysis of Tony Becher's *Academic Tribes and Territories* (Becher 1989; Becher and Trowler 2001). While not discarding the Biglan model or its essentialist aspects (although he did refute the life/non-life dimension), Becher headed in a new direction, developing two additional dimensions of disciplinary classification which were socially constructed, rather than based on subject matter, as all of the Biglan dimensions allegedly were (Biglan 1973a: 195). Becher's specification of rural/urban and convergent/divergent dimensions of disciplinarity refered respectively to the pace of

[45] I will look more at the notion of a 'natural' category in the chapter on Categorisation.

demand for scholarly results and the social cohesion of the disciplines.[46] As Becher states it, these can be used to better situate the disciplines and explain certain properties which came to light from his research which could not be explained by Biglan's dimensions alone, such as why both physicists and historians professed to have strong senses of disciplinary unity to their peers, while no other factors appeared to be similar between them (Becher 1989: 165). Becher considers these factors to be social, but, as Braxton and Hargens have noted, these may still be explained as results of subject matter creating a social determinant: again we are faced with the problem of indeterminable causality, and therefore a lack of expandability or predictability (Braxton and Hargens 1996).[47]

Sociocultural Models

Along with new metaphors, Becher's work brought a new methodology to the study of disciplinarity, non-statistical qualitative analysis. Like the 1972 report on interdisciplinarity, Becher's ethnography was not a 'first cause' but a landmark whose popularity helped usher in the now dominant sociocultural approach to understanding the disciplines. While the classification approach centred on statistical analysis, the sociocultural discussion has focused on qualitative research, social theory and historical analysis. Matters of pedagogy, methodology, epistemology and ontology factor highly in such discussions. It is not uncommon also for the language of the research to be different to reflect this focus, such as the interchangeable use of 'learning environment' and other terms for 'discipline' (Anderson and Day 2005: 321).

Sociocultural explanations examine how disciplines are socially formed, what properties or patterns this social construction has, and sometimes why the social construction has taken place in relation to previous social constructions and factors (Piaget 1972). Such approaches frequently lean towards *describing* disciplinarity as a social action more than *defining* it in a predictive or proscriptive way, under the notion that a definition is too objective or that disciplinarity is inherently too 'messy' to be generically defined (Messer-Davidow *et al.* 1993; Parker 2002; Moran 1999; Peters 1999; Moran 2010). Initial causal factors of disciplinarity, when these are addressed, are typically considered in terms of

[46] Becher is mostly known for the still popular metaphor for disciplinarity 'tribes and territories', but this metaphor focuses exclusively on the social aspect of the disciplines, which is not the focus of this thesis.
[47] The avoidance of directly addressing meaning or causality seems most obvious in Hargen's follow-up to his 1996 collaboration with Braxton, which is another statistical analysis of the Biglan model with the evocative title *Interpreting Biglan's Hard-Soft Dimension*, which does not in fact make any attempt to actually 'interpret'. It is also notable that following this study there do not appear to be any substantial quantitative surveys of the classification debate in the last 13 years. Perhaps the limitations of explanatory power of this method have been realised.

prior social conditions. In general this raises some of the same possibilities for unjustified underdetermination that were present in the HTRoI literature, such that it becomes difficult or impossible to decide which accounts are more or less reliable/effective. These methodological limitations are typically more directly recognised and engaged with in the sociocultural disciplinarity literature though, and more value is given to empirical evidence than in the HTRoI literature (though not in all cases).

Sociocultural approaches tend to range from the avowedly relativistic, through numerous types of relativist/realist blends, such as Critical Realism or Social Systems Theory, with varying degrees of success at balancing these (Messer-Davidow *et al.* 1993; Weingart 2000; Bernstein 2000; Anderson and Day 2005; Wellbery 2009; Moran 2010; Bhaskar 2010). Foucault-inspired power rhetoric also figures strongly in this tradition (Messer-Davidow *et al.* 1993; Lenoir 1993; Amariglio *et al.* 1993; Thompson-Klein 1996; Bernstein 2000; Parker 2002; Rosamond 2006; Trowler *et al.* 2012; Moran 2010; Wheelahan 2010; Ashwin *et al.* 2012). The blended models consistently offer the most compelling individual notions of disciplinarity, but often suffer considerably from attempts to balance realism and relativism without a strongly established epistemological structure for doing so. Critical Realism, for example, runs into problems with the claim that there are ‘social facts’ which have a pre-existent ontological reality from which social construction develops. This approach effectively revives the ‘final causes’ argument of Aristotelian natural science, which is both foundational and transcendental at once and therefore incoherent from a pragmatic stance (Wheelahan 2010; Bhaskar 2010). Other models, such as Ways of Thinking and Practicing or Social Practice Theory, which I will explore below, are more epistemologically compelling, and triangulation of these from a wider range of evidence may help expand the scope and reliability of the understanding of disciplinarity (and interdisciplinarity). Pragmatism and naturalised epistemology are almost never mentioned as options in the literature (for an exception see Allen, 2004).

Foucault and Power

Though it may seem counterintuitive, the ability to consider a hierarchical structure as a potentially positive and emancipatory notion is instrumental to disputing the essentialist model of disciplinarity and interdisciplinarity. This means reconsidering postmodern resistance to hierarchies or power relationships. Power and its effects on social construction of self and truth as a *starting point* for analysis is prominent in a substantial amount of the sociocultural literature on disciplinarity. This view has precursors in

Nietzsche, Marx, Adorno and others, but the most commonly cited source is Michele Foucault.

Summarising Foucault is difficult, his views evolved much over time. The source of his views on power though, are mostly articulated in (and cited from) *Discipline and Punish* and *The Subject and Power* (Foucault 1995, 1982). Here Foucault made eloquent arguments for an historical transition of modes of social control from overt authority exercised by a single ruler to obscured and socially constructed control by observation and normalisation. Foucault's argument was that individuals themselves had become complicit in creating the means of their own subjugation by generating a society in which we are all under constant observation and pressure to be 'normal'. Most importantly, Foucault characterised this power as an externalised 'machine' that was a pre-existing condition of all society and which always seeks to impose this controlling power (Foucault 1995: 139–40). Foucault was not explicit in *Discipline and Punish* that this control was negative; in fact he never directly said power was inherently negative in his writings. But it was strongly implied by Foucault's use of only negative examples of power, and the relation of these to what would typically be considered positive examples, "Is it surprising that prisons resemble factories, schools, barracks, hospitals, all of which resemble prisons?" (Foucault 1995: 228). This was made more apparent in *The Subject and Power* in which Foucault focused more on how to emancipate oneself from power structures, which begs the question why we would need to emancipate ourselves from something positive.

Much of the core HTRoI literature originated in the 1990s, when Foucault's star was arguably at its brightest. The presumption that the disciplines were first and foremost a means of exerting power and control *in an inherently negative sense* is explicit in several accounts and implicit in many more. The 1994 analysis of disciplinarity by Ellen Messer-Davidow, David Shumway and David Sylvan has been particularly influential in this regard, not least because Thompson-Klein's even more influential 1996 *Crossing Boundaries: Knowledge, Disciplinarities and Interdisciplinarities* was based on this source and drew many of its examples of disciplinarity from it though this source has appeared independently in other RoI literature. Messer-Davidow *et al.* were explicit in the Foucaultian nature of their analysis, as well as the assumption of the inherent negative aspects of power (Messer-Davidow *et al.* 1993: 3–15). Others have used Foucaultian analysis to suggest that academic qualification standards are a negative normalising force being used to suppress interdisciplinarity (Taylor 2009; Wheelahan 2010; Wexler 2012).

But there are problems with this negative reading of Foucault. The foremost is that Foucault's evidence does not well support such conclusions. His argument is historically based, but uses very few specific examples, nearly all several centuries old, which are then extended to form broad generalisations about the present. It is not at all clear that the examples are indicative of a pattern. More importantly, there is no substantial evidence of the *negative* power-based motivations or effects that Foucault implies are behind his examples, nor is there any clear relation between the types of power structures Foucault gives examples of and other types more commonly regarded as positive. Several pragmatists, particularly Jurgen Habermas and Richard Rorty, have expressed similar criticisms of the application of Foucault due to the failure to adequately demonstrate the negativity of power (Habermas 1986; Rorty 1986). Rorty has said, "There's a kind of formulaic leftist rhetoric that's been developed in the wake of Foucault, which permits you to exercise a kind of hermeneutics of suspicion on anything from the phonebook to Proust" (Knobe 1995).

The effects of Foucault's popularity as an integral figure in the development of sociocultural analysis of disciplinarity has been far reaching and has become deeply embedded, to the extent that power relations as a negative pre-condition in discussions of disciplinarity and hierarchical structures are often taken as a given. Although I acknowledge that in all social situations there is a relation of power present, and that this certainly has the potential to be negative and motivated by a desire to control, there has not been sufficient evidence given by Foucault to assume that this is necessarily or even frequently the case. Rather, I concur with Jan McArthur (2010: 308) that when power is exerted negatively by or within a discipline that this is an example of bad practice, not an example of the innate badness of disciplinarity. To presume a negative stance as a base is not merely pessimistic but it is another source of essentialism in the form of 'us versus them' dichotomies. The wider evidence I will review in the chapters that follow offers substantial reasons to reconsider hierarchies and power structures as an essential and even emancipatory aspect of disciplinarity and interdisciplinarity. It would be unwise to ignore Foucault's warnings entirely, however: we should remain vigilant against bad practice of power relations.

The 'Two Cultures' Revisited

C.P. Snow's 'two cultures' has been a regular theme in the sociocultural literature on disciplinarity. A substantial portion of the literature on this topic derives from the longstanding perception of the 'crisis in the humanities', wherein it is believed that the

existence of the humanities as a discreet area of study is in jeopardy (Arndt 2006; Hall 1990; Harpham 2005). This discussion has much in common with the 'us versus them' rhetoric of the HTRoI literature, and both the two cultures metaphor and the 'crisis in the humanities' are similarly essentialist by way of othering (Trowler 2012c: 91). Hounsell and Anderson (2007: 269) suggest that humanities and social science students, but by omission *not* science students, can be involved in critiquing their own disciplines. Jan Parker has suggested that disciplinarity in the humanities alone is defined primarily by pedagogy (Parker 2001: 31). This runs into trouble when it must be accepted that for this to be true, then teaching the natural sciences in the same manner must make them become humanities, which is clearly not Parker's intention. Ellie Chambers (2001: 5) has suggested that the humanities are distinguishable from science by the moral element inherently present in the subjects involved. While this may address a potential intrinsic quality of the subject matter, that humanities sources have a moral element, this model would imply that there is not a moral element to weapons research or particle physics because the weapons or particles themselves do not have intrinsic moral qualities. Although this argument could itself be challenged (that the moral aspects of weapons research are a matter for humanities scholarship), it is not clear why such a separation is either necessary or desirable. Chamber's elaborates that the moral aspect which defines the humanities is a normative and proscriptive role to seek social change, rather than an epistemological aspect of the subject matter. Such a model seems to present obvious problems for academic neutrality and therefore academic freedom/autonomy (Post 2009: 764).

Pure versus Applied Knowledge

Many 'betterness' claims for interdisciplinarity rest on the notion that is has more 'real-world' application, such as Boix-Mansilla and Duraising's definition which explicitly requires that interdisciplinarity serve an applied goal.[48] Although pure versus applied is often discussed in terms of disciplinarily, its core actually rests in the distinction between academia and the 'rest of the world'. On the one hand this can invite radical transdisciplinary responses such as mode 2 knowledge, project based curricula and staffing, or globalisation of the curriculum (Gibbons *et al.* 1994; Rosamond 2006; Taylor 2009). Alternately this can promote a retreat from application in the curriculum to remove knowledge production from training (Bernstein 2000).

[48] "the capacity to integrate knowledge and modes of thinking in two or more disciplines or established areas of expertise to produce a cognitive advancement – such as explaining a phenomenon, solving a problem, or creating a product – in ways that would have been impossible or unlikely through single disciplinary means" (Boix-Mansilla & Duraising, 2007, 219).

Gibbons *et al.* suggested that the world is moving towards a concept of practice and knowledge production as application-based interdisciplinary or extra-academic short-term projects (mode 2 knowledge), which supersedes the narrow confines of academic pure research represented by the disciplines (mode 1 knowledge). This approach has been further developed by Mark Taylor in a call to remove all disciplines and transform higher education, including staffing, to a fully short-term project based model (Taylor 2009). Gibbons *et al.*'s examples of mode 2 practices, however, are not clearly distinct from ordinary academic practice, but rather rest on the same strong notions of disciplinary essentialism that many interdisciplinary models derive from. This depends only on the author's assertion of what is or is not representative of a particular discipline to justify that one practice is disciplinary and another is not so. Any reliable difference between mode 1 and mode 2 knowledge would need to rest then on establishing a strong case for the existence of discrete mode 1 knowledge prior to mode 2 becoming the new norm, but like HTRoI efforts to do the same, this is not manifest in the literature. Instead, the focus of Gibbons *et al.* is on the nature of mode 2 knowledge with the presumption that mode 1 is a given, but this has not been substantiated historically.

Basil Bernstein's distinction between training and knowledge production makes more sense as a case for pure-applied distinction. Bernstein suggests that training into an applied field is different than education for the purpose of knowledge production, and historically this distinction appears more coherent (Bernstein 2000). In terms of the stated *intention* of each this is likely to be at least somewhat true, but is this essential and discreet or just another continuum which is arbitrarily divided? Is there any case of 'pure' knowledge production which cannot have application, and is there any practical application of training which cannot also lead to knowledge production?

There is only a need for such divisions in disciplinarity if it can be justified that there actually is 'pure' research which is 'unreal' or not applied, rather than simply research that is less obviously applied to the layman. *The notion that interdisciplinarity deals with more real-world problems as a defining criterion is based on such a misperception.* In fact it is easy to see examples of problem-based and real world application within any discipline on a near constant basis, finding an example of the opposite would be the difficult task, some are simply more commercially or politically relevant or more obviously useful to non-

experts.[49] The earliest professional degrees, Law, Medicine and Priesthood show this lack of dichotomy easily, as do more recent entries into the academic world such as Engineering and Economics. Each of these has both training and knowledge production aspects.

From the humanities and social sciences this is also true, as 'traditional' fields increasingly adopt a focus on work-placement and problem-based learning and digital humanities, largely as part of a broader employability agenda within the universities (Hawkins and Harvey 2011; Higher Education Academy 2013). Conversely, emerging fields such as Area Studies or Gender Studies continue to be considered interdisciplinary and applied to 'real-world' extra-academic issues in much of the current literature, but in practice these often function as disciplines with a strong focus on 'pure' academic research (Widerburg 2010). In fact it is not clear that it would be possible to find examples of any discipline that does not feature both aspects, only relative degrees of focus on one or the other. There is a distinct difference between something that *cannot* be applied and something that *is* not applied.

The Meaning of Evidence

There is something of consensus within the academic community that what each discipline considers to be valid and reliable evidence is a core element of disciplinary identity. This is well supported and broadly triangulated in much of the literature:

- "The concept of evidence is arguably the most fundamental concept in all disciplinary enquiry" (Rowland 2006: 93).
- In particular, it brings into central focus the ways in which individual disciplines represent (or at least debate) the nature of knowledge in their domains, what counts as 'evidence' and the processes of creating, judging and validating knowledge (Hounsell and Anderson 2007: 496).
- "Signature pedagogies are important precisely because they are pervasive. They implicitly define what counts as knowledge in a field and how things can become known" (Shulman 2005: 54).
- "Soft science is soft because of the nature of the subject matter" (Greaves & Grant 2010: 331).

This notion is problematic as a definitive end point for defining disciplinarity though, because in pragmatic terms it is incomplete. Few authors leave the notion of evidence unqualified as a defining factor; nevertheless it does stand as a *de facto* end point in much

[49] Notably this is not the same as saying all disciplines are preparing students for real jobs and employability. Many of the 'real-world' applications being taught may not correspond well to jobs which are likely to exist for students when they leave. These are separate issues.

of the sociocultural literature given that what each discipline considers ‘good’ evidence is clearly a socially constructed matter and therefore not in need of further reduction. In pragmatic terms, this is unjustifiably underdetermined because it does not adequately explore the conditions which give rise to the social practices that determine what is ‘good’ evidence, and whether some of these are more effective or reliable than others.

A discipline’s approach to evidence may open a door to undoing essentialism by defining discipline by a fluid element, which makes it a compelling potential aspect of a new definition of interdisciplinarity. But without a deeper understanding of what ‘approach to evidence’ means and how it relates to practice the model may instead *enhance* essentialist approaches, as well as promote relativistic pluralism by validating an ‘anything goes’ approach to disciplinary identity. ‘Approach to evidence’ alone is both a relativistic definition of disciplinarity that allows each discipline to be internally self-justifying by its own epistemic criteria, and it is also more description than definition (Parker 2002; Kreber 2009).

Subject Matter

That disciplines are related to the subject they are roughly based around is neither a new concept, nor is it typically contentious. It is a common element in much of the literature on interdisciplinarity, generic skills, and disciplinarity, and it appeared steadily throughout my interviews with medievalists. In order to look deeper into ‘approach to evidence’ as a possible defining factor of disciplinarity, it will be useful to look at how the concept of subject matter has been handled in the literature. Many sources discuss the inherent status of subject matter briefly, but invariably this is either set aside to consider more complicated sociocultural aspects, presumed without explanation in order to classify disciplines, or presumed without explanation in order to define interdisciplinarity (Biglan 1973b; Newell and Green 1982; Moore 2004; 2011; Szostak 2008; Trowler 2012b; MacKinnon *et al.* 2013). Where I differ from most accounts on this issue is that I see more value in resting here, and evaluating what these core aspects mean devoid of or as foundational to the many complex social and traditional structures which make up much of the discussion on what disciplines are and how they function.

What ‘subject matter’ actually *is*, however, is an ontological question, one which is inherently foundational or transcendental and is therefore incoherent from a pragmatic perspective. What is more useful to pursue is whether there are patterns and stability to be found in the conditions which lead to our differentiation of subject matters, particularly at

levels beyond the disciplines themselves. For example, Lee Shulman (2005: 54) suggests that disciplines (at least professional ones) can be distinguished by 'signature pedagogies' which are inextricably linked to the social practices and enculturation into the discipline. In his descriptions of these practices, however, Schulman consistently notes that the *subject* of the pedagogy is the chief aspect that makes it 'signature'. This suggests the underlying subject matter is a condition which gives rise to the social practices which provide the stable core of pedagogies that Schulman found. Similarly, in reviewing the field of Geography Warren Moran notes, "Although it has the flavor of determinism, I wish to argue that geography shapes what the discipline of geography is and what geography does" (Moran 1999: 128). Consideration of the conditions of social practice in turn leads back to the nature of 'evidence' as it is seen by different disciplines, and whether there can be any stable, empirical and non-relativistic framework for this which might then enhance our understanding of interdisciplinarity and how to teach it. The psychology of categorisation (chapter 6) has much to say on this matter, as well as research into expertise (chapter 5).

There is another elephant in the room though: what creates the apparent distinction between disciplines which look at the same, or nearly the same, subject matter? Historians and literary scholars, for example, may both look at the biographies of medieval saints as primary sources. How are these disciplines to be seen as different if all that defines them is a generic epistemology common to all academic study (the scientific method) and the more specific epistemological qualities of a *common* source material? Many HTRoI discussions of disciplinarity have attributed the distinction to the methodology that the disciplines employ, but this relies on problematic presumptions of disciplinary essentialism and disciplinary ownership such that a discipline actually has the right or ability to 'own' a method. Most recognised disciplines can and do use an array of methodologies for different purposes without being considered interdisciplinary for doing so. The methodology explanation does not suggest why a multiple methodologies approach used on the same source type sometimes constitutes different disciplines and sometimes not (Thompson-Klein 1996; Bromme 2000; MacKinnon *et al.* 2013).

A number of discussions of disciplinarity independent from interdisciplinarity have suggested that the answer is in the questions the discipline asks of the common subject (Becher 1989; Bernstein 2000; Moore 2004; 2011; Rowland 2006). This seems more plausible because it relies on a consensus of intent or purpose, rather than dubiously attributed ownership of methods, but it still leaves open the question of why distinctions are made at certain points, and why some appear to shift rapidly while others barely shift at

all. Why do we not typically consider what the historian and the literary scholar ask of the saint's biographies to be part of the same discipline, and are there conditions in which this might change? A deeper look at the psychology of categorisation will help us to understand this process.

Generic Skills, Critical Skills and Transferable Skills

There is another area of higher education research which is of considerable use for understanding the nature of disciplines and interdisciplinarity, the on-going discussion over generic skills or 'graduate attributes'. Graduate attributes, also sometimes referred to as critical skills, transferable skills or employability skills, are meant to be non-discipline specific skills that all students should be expected to develop during the course of an undergraduate degree. The specific skills involved vary from one university or study to the next, but there is some degree of consistency. Of the four universities I reviewed the attributes for, no two featured the same list, and there was considerable difference in how they were arranged, grouped and presented, almost as if everyone were trying to be the most original at doing the same thing. In Kuhnian terms it appears that a new master paradigm has taken a fairly solid hold, the graduate attributes agenda in general, but now there is paradigm revolution and chaos at a hierarchically more nuanced level within this around the questions of implementation and presentation.

The University of Glasgow has ten attributes with a matrix of three sets of descriptions of how the attributes apply to students, academics, and professions. The University of Aberdeen has nineteen total attributes grouped into four categories. Edinburgh Napier University has the same layout, but instead of university wide attributes, each subject has their own set (I have used English as my example). Finally the University of Edinburgh have seven attributes arranged in two concentric circles with four in the centre and three encompassing these. Regardless of the substantial differences in presentation, there are very strong similarities in the nature of the attributes across all four universities (and in fact several others which I viewed). Each of the sets featured essentially the following:

Students should graduate as

- Subject experts
- Ethically, socially and culturally aware, typically often in terms of global citizenry
- Self-motivated, reflective, open-minded and investigative learners
- Effective communicators and collaborators, often across disciplines
- Self-confident, able to present self and make arguments

- Critical thinkers in a general sense

The principle of graduate attributes is that these skills do/should exist independently above, around or within all of the disciplines: critical to a complete education for all students, but not specific to any discipline (Barrie and Prosser 2004; Barrie 2005, 2006; Sumsion and Goodfellow 2004). Clearly some of these skills above directly relate to the most consensual aspects of interdisciplinarity noted in the first chapter, collaboration and communication, and indeed these often include direct mention of interdisciplinarity or working across disciplines in the lists of attributes. But there are important reasons why the graduate attributes agenda is not 'magic bullet' to interdisciplinary learning.

The main difficulty with applying graduate attributes to interdisciplinarity lies in understanding the two sides of the debate over how to implement them in the curriculum. The discipline specific argument states that such skills can only be learned within a disciplinary context, and that they then either apply only within applications of that discipline, or they will automatically generalise themselves later (views on this aspect differ substantially) (Moore 2004; 2011). The generic skills training argument holds that such skills are inherently generic to all disciplines and need to be taught separate from disciplinary learning (Davies 2006; 2013; Davies and Devlin 2010). These represent extreme views and pedagogic approaches to graduate attributes. But embedding the attributes into the objectives and teaching of most or all courses, while also maintaining some degree of centralised unity among the attributes, appears to be a broad consensus (Moore 2004, 2011; Sumsion and Goodfellow 2004; Barrie 2005, 2006; Davies 2006, 2013). In terms of interdisciplinarity neither argument addresses learning such skills *across* the disciplines, though in each case knowledge transfer or the generalising of the skills is presumed to happen at some point. There is, however, strong evidence that the efficacy of knowledge transfer in such cases may be grossly overstated (see chapter 5).

Graduate attributes evolved chiefly from a focus on universities developing broader employability in graduates, though most current sets of attributes also make space for aspects of global citizenship as part of this (Barrie and Prosser 2004; Sumsion and Goodfellow 2004). The focus on employability as something which requires skills and abilities beyond the disciplines may suggest similarities to claims about the more 'real-world' nature of interdisciplinarity, but a comparison would be premature. Both the degree to which graduate attributes actually transfer beyond the disciplines and the degree to

which ‘real-world’ generic skills are developed by interdisciplinarity are questionable and are not backed by much evidence yet.

Recent Approaches to Disciplinarity

One compelling recent analysis of the nature of disciplinarity is Ways of Thinking and Practicing (WTP). WTP was developed as part of a large qualitative study of disciplinarity at the University of Edinburgh. The project independently reviewed undergraduate practices in Biosciences, History, Economics, and Electronic Engineering. For evidence researchers triangulated student views at the beginning and end their degrees, staff views of what they felt they were teaching or wanted to impart, existing literature on the nature of each discipline studied, and actual student work (McCune and Hounsell 2005; Anderson and Day 2005). Subsequent attention has been focused mostly on the reviews of History and Biosciences (Anderson and Hounsell 2007; Hounsell and Anderson 2009).

Within each subject the results showed that students formed a clear overall unity in ways they thought about the subject by the end of their degree, which was closely related to what the lecturers hoped would be gained and which was also supported by their assessed work; this was proposed as evidence of disciplinary ways of thinking and practicing. Diane Laurillard (2012: 21–22) has suggested there is another way to read the results, however, if the separate reports are compared side by side. What Laurillard discovered was that the goals that instructors had for their respective programmes were highly consistent across all of the programmes. After substituting any obvious subject specific wording for more generic terms, Laurillard quizzed instructors at her own institution to say which applied to their field. She found that:

> “Across subjects as diverse as math, sociology, philosophy, cognitive science, and computer science, four of the 43 ETL items were identified by the majority of teachers as ‘irrelevant’, while 17 (40%) were seen as ‘relevant’ by more than 75% of them...The commonality across disciplines of the relevance of these general statements of learning outcome is quite high, and suggests that although some learning outcomes are clearly unique to a subject discipline, there can be broad agreement on many of the aspirations of formal learning in terms of cognitive competencies being developed” (Laurillard 2012: 23).

What this implies is not disciplinary thinking but a general way of thinking common to academic study, one which works at a hierarchical level of abstraction from subject specific detail. Such similarities were also noted by Becher and others who found that biologists reported as much concern for uncertainty of knowledge as historians (Becher 1989: 15; Shopkow *et al.* 2013). Similar results have been found in a study by Susan Lea

and Lynne Callaghan, "...differences between academic cultures and their disciplinary epistemologies...did not emerge very strongly..." (Lea and Callaghan 2008: 218).

The WTP studies may have inadvertently supplied a significant empirical foundation for the high-level unity of academic thinking around the scientific method discussed in the previous chapters, as well as substantially undermining classification models of disciplinary essentialism such as the 'two cultures' or hard/soft. Further, these findings support the notion of graduate attributes as a potential means to both facilitate teaching these traits, *but also as a common means of translating concepts across the disciplines.*

Ways of Thinking and Practicing was meant to support disciplinary distinction (in a fluid and evolving way, not essentialist), but other recent publications have increased the pace of critique of disciplinarity itself. In a recent edited collection, *Tribes and Territories in the 21st Century*, Paul Trowler, Murray Saunders and Veronica Bamber (2012) develop Social Practice Theory (SPT) as a fairly nuanced yet structured attempt to resolve some of the problems of balance between realism and relativism. The SPT approach focuses less on the rhetoric of social construction, and more on the tangible evidence of social practice; decentring the individual as the subject of study and placing the emphasis on the demonstrable social practice itself. In this sense it appears to be a pragmatic model (Trowler 2012b: 30-34). The SPT approach to disciplinarity serves to substantially problematise the traditional views of essentialism and boundaries, while not outright dissolving them. A wide array of models and approaches to disciplinarity and beyond are discussed in the chapter of the collection, some more compelling than others. A consistent trend across them all, however, is a direct challenge to the notion of discipline as fixed and essential, while also not venturing into the realm of radical transdisciplinarity; i.e. disciplinarity was seen to still have substantial practical value for organising research and teaching even if most of the boundaries are both protean and chimerical. But although it is a compelling approach, the application of SPT in the text remains somewhat theoretical and focused on sociological discourse and case studies: it might be expanded further.

For example, Saunders notes, "We argue that any useful theory of knowledge and of disciplines needs to see them as being to some extent socially constructed, but at the same time recognising that knowledge is objective in ways which transcend the historical conditions of its production" (Saunders 2012: 170). In Trowler's discussions as well there are several hints towards a deeper level of constraints or underlying structure to the disciplines, but these are not explored specifically in the text (Trowler 2009, 2012c, 2012a).

There is limited triangulation from other types of evidence which could be illuminating, such as psychology or other research specialisations outside of curriculum research and case studies of practice within the disciplines. Because SPT is a similarly pragmatic and evidence-based (i.e. naturalised) approach, my consideration of the psychology of expertise, categorisation and knowledge transfer in the following chapters should prove complementary to the evidence already presented by focusing on the demonstrable conditions from which social practices may arise, and therefore providing an additional degree of triangulation.

Summary

My main focus here has been to further undermine the notion of disciplinary essentialism through the lens of what is said about the disciplines themselves apart from interdisciplinarity. The unintended evidence of the WTP project has been strong in questioning which perceived differences in disciplines are actually as different as they seem, and the graduate attributes debate further develops the notion of academic unity of understanding and practice (as discussed in the previous chapter on epistemology). The perpetuation of Biglan's categorical system of disciplinary distinction, especially now in more subtle and embedded forms continues to promote the notion of disciplinary essentialism though. The crisis in the humanities has created a long-running 'us versus them' discussion of how the humanities are distinctly different from science (hard/soft), often fuelled by Foucaultian notions of social emancipation and power hegemonies, but most of these distinctions fail to stand up to critical analysis. The pure versus applied debate has also continued in the form of either resistance to HE as training (Bernstein 2000) or resistance to HE as not training (Gibbons *et al.* 1994; Taylor 2009). SPT offers a new approach to disciplinarity as a continuum. Carrying on from a number of empirical studies such as Becher's, the SPT model approaches disciplinarity as something more fluid and unregimented than a simple categorical structure. The work done with SPT so far though has only produced a narrow band of evidence, and not all of this appears to refute essentialism. Looking now to entirely new sources of data on disciplinarity and interdisciplinarity, I hope to add more types of evidence to the SPT structure and triangulate a more complete model.

Chapter 5: Expertise (Knowledge Transfer, Qualifications and Transactive Memory Systems)

Introduction

In this chapter I will consider the empirical research in the specialist fields focused on the psychology (and some sociology) of expertise, knowledge transfer, and transactive memory systems (group cognition). I will also consider in more detail the purpose and processes for developing both subject specific and generic academic standards and qualifications frameworks. Expertise research is the most robust of these, and aspects of a deeper understanding of expertise extend into the understanding of each of the other topics in this chapter, as well as the following chapter on categorisation. Expertise research suggests a number of things which have a direct bearing on some neglected or assumed understandings about disciplinarity, and many of these are presented via strong empirical evidence. Applying the lessons learned in this field should go a long way to settling some disputes and cyclic debates about the disciplines and interdisciplinarity. First I will investigate the nature of expertise and the study of it, establishing the core findings of the field and how these relate, often directly, to understanding interdisciplinarity. Then I will explore the current research in each of the other fields, relating this both to interdisciplinarity and to expertise research. The evidence in this chapter will make a strong case for how interdisciplinarity might best be defined, and also how it may best be developed in an undergraduate curriculum.

Core Principles of Expertise

Expertise is a commonly used term, but like many common terms it also has a technical meaning in academic study. In common use expertise can refer to any example of considerable skill at a thing, with fairly vague criteria for what does or does not qualify. This is consistently how it has been applied to disciplinarity and interdisciplinarity. In the academic (often called ‘scientific’) study of expertise the definition is similar, but the criteria become much more particular. Expertise researcher K. Anders Ericsson defines expertise as, “The acquisition of reproducible superior performance on domain-specific tasks...” (Ericsson 2005: 238). Expertise research focuses on such questions as:

- Is expertise qualitatively or quantitatively different from mere competence,
- is expertise socially constructed or objectively definable,

- are there multiple types of expertise,
- can expertise be learned without limit or is our potential innate,
- is expertise a generic skill/trait or is it domain/subject specific,
- are there downsides to expertise,
- how do we acquire expertise?

It might be expected that since the study of expertise looks at all of these aspects of subject-based skill development, it would have strong links to the study of academic disciplinarity, but this has not been the case. Researchers of expertise have only infrequently addressed academic learning, and even less in terms of disciplinarity:

- Chi *et al.* (1981, 1988) who looked at various student and expert problem solving abilities in physics;
- Voss, Greene, Post, and Penner (1983) who looked at reasoning in political science between experts, novices, and non-politics experts (chemists);
- Wineburg (1991) looked at how expert historians read and review sources differently in practice from novices;
- Schunn and Anderson (1999) looked at specialised and generic hierarchies of expertise within psychology.

Nevertheless, expertise research has basic similarities with Educational Studies: both ask some form of the question 'how do we develop knowledge or skill in a particular area?'[53]

There are a number of seemingly essential connections to disciplinarity, and by extension interdisciplinarity, which have been hinted at or suggested by some expertise researchers, but which have not yet been explicitly pursued. Although in the broad field of education studies there has been some crossover with expertise research, in the specific focus that deals with disciplinarity there has been almost none; expertise research is an elephant in the room in the discussion of what a discipline is and why we have them. Expertise instead remains an assumed background value: sometimes it is acknowledged briefly, but seldom in any detail. Expertise is touched on slightly more in interdisciplinary research, but still via 'common usage' of the term, rather than engagement with or acknowledgement of actual research on the subject.

[53] This dichotomy itself is an interesting look at the separation of disciplinarity, as it could be argued on several grounds that expertise research and theory of learning research are indistinguishable, while from other perspectives they are clearly different fields of study.

This disconnect can be seen clearly in the number of references within the literature. In the forty-two chapters of the *Cambridge Handbook of Expertise and Expert Performance* (Ericsson *et al.* 2006) there is no direct or sustained discussion of HE training, disciplines or academic development, even in the two chapters specifically focused on the socialisation of expertise. The only mention that is made is a brief account of the training phase of professional development and several citations of Chi, Glasser, and Farr's (1988) landmark study of expertise development in physics, which does not address disciplinarity, merely expertise development in a specific context.

Conversely there are no citations of any of the eighty-five contributors to the *Cambridge Handbook of Expertise and Expert Performance* in the two most substantial recent edited collections on disciplinarity *The University and its Disciplines* (2007) and *Beyond Disciplinarity: Tribes and Territories for the 21st Century* (2012).[54] The same is true of recent collections of research on interdisciplinarity. The *Cambridge Handbook of Interdisciplinarity* (2011) contains no references to expertise research, and the edited collections *Interdisciplinarity in Higher Education: Perspectives and Practicalities* (2010) and *Interdisciplinary Learning and Teaching in Higher Education* (2010) contain only one.[55]

Expertise research is not a magic bullet to resolving interdisciplinarity though; many points within the field remain under debate, and many questions about disciplinarity still lie outside of anything covered under expertise. Although much of the existing research seems that it can be directly related to disciplinarity, we must be careful in making jumps the original researchers did not intend, and in using empirical data differently than the purpose it was gathered for. Expertise research has only barely touched on issues outside of those which are easily quantifiable; leaving a possible question whether something fundamental may be different between academic disciplinarity and the more conventional fare of expertise research. These caveats must be firmly held in mind when considering any potential links between the fields. That said, evidence from within the disciplines themselves seems to match up quite well to what expertise research reveals.

[54] Excluding Robert Sternberg, who is cited for Cognitive Styles, not his work on expertise.
[55] Martin Davies and Marcia Devlin (2010) include a brief but direct discussion of Chi, Glasser, and Farr (1988) and Johnstone (2003), and the possible problems these create for much of interdisciplinary theory; this is the only such reference I have encountered in any source on interdisciplinarity, though it is promising.

Research Paradigm of Expertise Study

Ericsson's definition of expertise included the term 'reproducible', and this is critical for understanding the predominant research paradigm of the field:

> "The first step in a science of expert performance requires that scientists be able to capture, with standardised tests, the reproducibly superior performance of some individuals, and then be able to examine this performance with laboratory methods...
>
> ...a complete understanding of the structure and acquisition of excellence will be possible only in domains in which experts exhibit objectively superior performance, in a reproducible manner, for the representative activities that define the essence of accomplishment in a given domain" (Ericsson 2006a: 686-7).

These requirements are a response to a perennial problem with researching expertise which is well recognised within the field (though not in all cases acted on): many socially acknowledged 'experts' actually fail to demonstrate abilities much beyond a novice in their fields. This was noted in a number of studies by Ericsson, who lamented not being able to get reliable results because he could not find reliable experts:

> "In most domains information about the objective performance of experts was not available, and investigators defined expertise by social indices and by the length of their professional experience" (Ericsson 2005: 235).
>
> "the focus should not be on socially recognised experts, but rather on individuals who exhibit reproducibly superior performance on representative, authentic tasks in their field" (Ericsson 2006: 686).

Ericsson's statements may seem to doom any attempt to apply expertise research to the study of interdisciplinarity because the applications of interdisciplinarity are not typically a laboratory reproducible matter.[56] But although Ericsson is certainly one of the most recognised and generally respected names in expertise research, and most other researchers in the field work follow the same strongly empirical paradigm, most make more allowance for situational conditions and merely incorporate this into their interpretation (Schunn and Anderson 1999; Bromme 2000; Evetts *et al.* 2006; Kellogg 2006; Voss and Wiley 2006). Recently a number of sociologically focused perspectives on the development and expression of expertise have also emerged (Evetts *et al.* 2006). Some of these are of special importance to the connection between expertise and interdisciplinarity, especially the work of Eduardo Salas (2006) on expert teams. These sociological studies are predominately empirical and therefore integrate well with the still dominant psychological paradigm of expertise research into an emerging psycho-social paradigm.

[56] Some of the work emerging from the RoIR tradition may be approaching this, but there would need to be many more examples, all reasonably comparable, to be sufficient.

Chunking and Miller's Law

To understand expertise research we first need to understand something called Miller's Law. In 1956 George Miller published a still influential synthesis of patterns of memory and recall which demonstrated that humans have a fixed and limited amount of short term working memory (STWM): 7-9 independent meaningful concepts at a time.[57] He called these singular units 'chunks', and the creating of these meaningful units 'chunking'. [58] The human limit of 7-9 memory chunks has been replicated and refined considerably and is now referred to as Miller's Law (Baddeley 1994). The most essential aspect of chunking in terms of expertise and learning though, is that Miller found that some people seemed to be able to recall things in more complex chunks (Miller 1956: 93). This meant that although the rule of 7-9 concepts at a time remained consistent over an array of studies, some people were able to recall more *total* information because more meaningful information was stored in each chunk.

Miller's work formed a foundation for expertise research, but it was the work of Chase and Simon (1973) on skill development in chess that made the link to learning processes and to understanding what expertise actually meant.[59] They found that novices (players who were familiar with the game rules, but were of very limited experience or practice) could only correctly remember the locations of three to four pieces from a complete chess board if shown it for a few seconds, while chess masters could consistently recall the entire layout, and could even make statements about how it got there or who was winning (Chase and Simon 1973). Their hypothesis was that the experts were using meaningful short-cuts to notice key features of the board, in order to store the entire layout as a recognised pattern in the same amount of fixed mental 'space' that a novice was able to store substantially less meaningful information. Through a series of human and computer experiments they developed Miller's chunking model into a theory of human expertise development which said that although STWM was limited to 7-9 chunks, as any person increases in skill they learn to form more *complex and meaningful* chunks *and* to store them in Long Term

[57] "Short-term memory (or "primary" or "active memory") is the capacity for holding a small amount of information in mind in an active, readily available state for a short period of time. The duration of short-term memory (when rehearsal or active maintenance is prevented) is believed to be in the order of seconds. A commonly cited capacity is 7 ± 2 elements" (MedicineNet.com 2013; Wikipedia 2014)

[58] That STWM is a fixed quantity in humans remains the primary view today, although there is some recent research which suggests there may be limits to this model, or some flexibility (Hill and Schneider 2006: 662)

[59] It is interesting to note that this is the same year that Anthony Biglan published his model of classification of the disciplines, effectively launching the modern study of disciplinarity. The simultaneous early development of these fields may help in understanding how they remained unaware of each for so long, each being more busy developing its own identity.

Memory (LTM) in more meaningful and easily accessible patterns (Chase and Simon 1973; Gobet 1996).

Although there have been some criticisms of the chunking model, and it has certainly evolved in complexity, especially with advances in neurological imaging and memory models, it has remained amazingly resilient as a basic model of expertise development, and continues to be the foundation of most other discussion in the field.

Chunking and Language

The chunking model also presents the first major link between expertise research and disciplinarity research, in the form of the need for specialised academic languages. Language has been an area of much surface level discussion within some literature on interdisciplinarity, and more importantly has been the focus of considerable empirical study within the disciplines by Paul Hyland and others (Hyland 2006; Thompson-Klein 1990, 1996). These have focused on the sociocultural aspects of communication between the disciplines, often with a Foucault-inspired understanding of power relations as negative and elite cultural structures (Messer-Davidow *et al.* 1993; Amariglio *et al.* 1993; Rosamond 2006; Chettiparamb 2007). A direct connection between these and expertise research has not been made.

Expertise research provides considerable empirical evidence that complex and technical domain languages are necessary elements of increasing skill and understanding. In order for more effective chunking operations to take place, and for faster more accurate memory and recall to happen, more comprehensive terms are required, terms which encompass more nuance in the same cognitive ‘space’. For example in chess a novice must describe the entire board in detail to explain where the pieces are, but an expert can say 'king defence configuration' and mean the same thing (Gobet 1996; Ericsson 2006). Additionally, the expert’s statement carries more information for other experts, such as prior and subsequent likely positions, and who is winning.

An example from the discipline of History might be that a novice would have to describe at length the reasons and methods for paying special attention to the perspectives of non-western peoples in the historical account, especially when they are the focal subject, while an expert can simply mention ‘post-colonialism’ or ‘orientalism’ and convey the same ideas, again including extra information as well such as the historiographic debates around these terms. Further the expert can distinguish nuanced differences in the technical terms

of the discipline, such as that post-colonialism and orientalism, though related, are not the same thing. A novice historian might also have to describe the events and situations of the Restoration in detail, while an expert could gain all of the same information from the term alone, as well as more advanced information about causes and effects of the period.

Traits of Experts

Over the previous four decades of expertise research, a fairly consistent and well evidenced set of basic traits of experts has emerged. The evidence for each is varied, usually being researched in very different contexts over a number of different studies by different researchers, but in aggregate the evidence is compelling.[60] More interesting is that this research has shown consistently that there are about as many 'negative' traits associated with expertise as there are beneficial ones. A list of these traits, both positive and negative, was compiled by Michelene Chi (Chi 2006).

> Experts have been demonstrated to be quantitatively and qualitatively better than non-experts at:
>
> - Generating the best solutions faster and more accurately
> - Detecting and recognising nuance, complex patterns and deep structures
> - Qualitatively analysing subject specific information
> - Self-monitoring, i.e. knowing what they do not know and detecting errors
> - Choosing effective strategies
> - Confident risk-taking
> - Minimising cognitive effort and maximising cognitive control
>
> Experts, however, have been shown to exhibit a number of less desirable traits as well:
>
> - Failure to demonstrate expert traits outside of limited subject domain
> - Contextual limitations on expert abilities even within specialised domain
> - Inaccurate perception of novice/non-expert understanding
> - Glossing over surface elements
> - Inflexible thinking
> - Overconfidence
> - Bias towards personal experience and personal 'best' knowledge.

[60] This should not be carried too far, however. Although the general traits below are well agreed upon within the field, the field has been so far rather narrow in its empirical scope. Also it could be argued that the field in general could benefit from more cross-checking and replication of older key studies, as some results are still regarded as sufficiently evidenced without re-evaluation in several decades. This does not mean the original results are themselves uncompelling, however, some situations or environments in which the research was conducted may have substantially changed. Also it is important to remember that these traits of experts are not absolute, but are relative to novices and non-experts, and that the practical manifestations of them will vary widely depending on all aspects of context.

These will serve as a starting point for further discussion about some of these traits, our understanding of how they come to be, and how they may relate to disciplinarity and interdisciplinarity.

It is clear that several of the positive and negative traits above are opposite aspects of the same concept. Although experts are more confident risk takers, they can also be overconfident. Although experts are substantially better at grasping deep structures of knowledge, they can also gloss over surface details, which are sometimes critically important. In a similar vein experts display a tendency towards stereotyping, by tacitly adding patterns to their personal experience which often do not have a verified causal connections, such as basing medical diagnosis in part on sex, race, etc. when these are not verified (Chi 2006: 27).[61]

These pairs are particularly important when considering interdisciplinary curriculum designs. Chi and other expertise researchers do not say much about the causes of the differences in terms of curriculum or pedagogy, but some possible reasons for (and solutions to) the counterbalance of positive and negative traits are suggested by educational research on 'personal epistemologies'. Personal epistemology is, "a field that examines what individuals believe about how knowing occurs, what counts as knowledge and where it resides, and how knowledge is constructed and evaluated" (Hofer 2004b: 1).[62] The work began with William Perry in 1970, who proposed a developmental stages model of the epistemological complexity of student thinking (Perry 1999). Work since, led much by Marlene Schommer-Aikens, has moved away from developmental stages as the underlying factor, and more towards the nature of a student's *beliefs* about knowledge and knowing: epistemology as viewpoint and pedagogy (Schommer 1990; Schommer-Aikins *et al.* 2003; Schommer-Aikins 2004). Studies in this field have demonstrated that different learners respond differently to the same instruction based on what preconceptions about knowledge and learning they come to it with and/or how it is presented. Students with personal epistemologies which included believing in discreetly separate bits of knowledge, intelligence and learning ability fixed at birth, The learning is quick or not-at-all, and that knowledge once learned is certain (all highly positivistic traits) also showed considerably less reflective judgement (overconfidence and inflexible thinking), more likelihood to draw absolute conclusions from tentative information (personal experience bias), and weaker comprehension of texts (glossing over surface details). Students approaching with the

[61] More in the chapter on categorisation
[62] Carol Dweck's recent concept of 'fixed' and 'growth' mindsets appear similar as well (Dweck 2012).

opposite perspectives typically achieved the opposite results, in line with the 'positive' expertise traits (Schommer-Aikins 2004: 27).

In terms of expertise, personal epistemology as an explanatory model suggests that some experts approach expertise or are instructed to see expertise as both deeper *and* broader levels of nuance, interconnectivity, uncertainty, and learn to recognise the limitations that narrowing their focus creates. Others, however, appear to perceive expert knowledge as absolute and uncontested, the pinnacle of development such that what an expert knows simply is and an expert's judgement is simply correct, because this is how they have perceived experts before them or it is how they have been instructed to look at knowledge.[63] Interdisciplinarity as a form of decontextualisation or decentering of expertise may have some ability to reduce these problems. The nature of the negative traits suggests though, that competency interdisciplinarity is not the way to go, however, because of its focus on increasing decision making confidence without developing the subject expertise required for self-monitoring and dealing with deep structures. It appears to promote the negative side of expertise.[64]

The personal epistemology approach of Barbara Hofer (2004) offers a different path for developing a curriculum model of interdisciplinarity (one that promotes flexible instead of inflexible expertise). Hofer suggests that epistemological stance can be trained and shaped as a metacognitive skill which can then be applied to multiple settings, "Such theories develop in interaction with the environment, are influenced by culture and education and other context variables, operate at both domain-general and domain-specific level, are situated in practice, and are activated in context" (Hofer 2004a: 46). Hofer does not discuss practical means of developing these reflective metacognitive skills.

Automaticity & Cognitive Entrenchment

Research on expertise has identified at least one basic psychological/neurological mechanism of expertise performance, called automaticity, which states that as we learn skills they eventually become automatic and can then be performed with less attention, faster, more consistently, and while focusing on other tasks (Feltovich *et al.* 2006: 58). The

[63] Research specifically focused on personal epistemologies and expert traits would be helpful.
[64] The paradox of this is that many IDS programmes claim to explicitly train students in 'interdisciplinary thinking' but because this is still based on an individual as 'interdisciplinarian' model this inherently requires viewing interdisciplinarity as a surface level and positivistic process that one person can learn quickly and execute with certainty. This is a positivistic misperception of interdisciplinary thinking as crossing of essentialist disciplinary borders instead of developing reflective skills.

same research has also found that automaticity is essential to developing higher levels of expertise, particularly abstracted thought, knowledge transfer and manipulations of the underlying knowledge. Expertise researchers Lesgold and Resnick (1982) found that if children as young as kindergarten age did not automatise their basic reading skills then they would not be able to develop the same reading comprehension and word manipulation skills of their peers years later (Feltovich *et al.* 2006: 53).

Automaticity has also been strongly supported by neurological data in a series of studies which compared fMRI scans of regions and amounts of brain activity as participants progressed from novice through extended practice to skilled levels at various basic tasks (Hill & Schneider 2006).[65] Some practice periods lasted a short time, such as an hour, others charted progress over weeks of practice. In the early stages much more of the brain was active, and this activity was in domain general 'learning' regions such as visual and spatial processing or generic control centres, while by the end of practising far less of the brain was actively used when completing the task, and the active areas had moved to regions associated specifically with the type of task. Moreover in the earlier stages participants could adapt to changes in the task and learn new patterns easily, but also their accuracy was strongly effected by distractions or fatigue, while at the end they could not easily change or adapt the process to incorporate new elements, but could perform the task consistently and accurately while also performing other tasks or when tired. The conclusion was that the tasks once practised and committed to LTM became both rigid and inflexible in the face of new conditions, but automatic and able to be completed with minimal effort as a part of other tasks.

The rigidity of automaticity has serious implications for interdisciplinarity as it suggests that expert knowledge may be inflexible and unable to be expanded or be revised to cope with new interdisciplinary input or working effectively with other disciplines. Erik Dane (2010) has labelled this bleak overall picture 'cognitive entrenchment', but he has also suggested some methods for mitigating the problem. There are concerns with Dane's approach, however, which highlight further issues with competency interdisciplinarity. Dane suggests that resisting developing 'too much' expertise, working in dynamic environments and focusing on non-domain tasks can mitigate entrenchment (Dane

[65] fMRI is one form of brain activity scanning which is used to determine which areas of the brain are active during particular tasks. Notably, fMRI are only accurate to somewhat general regions of the brain, which can often house processors for several different types of mental activity. In the case here the activities being scanned took place in different regions, so overlap was not an issue.

2010: 589). Unfortunately Dane's recommendations are somewhat simplistic and rhetorical, i.e. not accompanied with evidence or examples of actual practice.

Solutions such as this lend fuel to competency interdisciplinarity rationales for lowering the overall level of expert knowledge in each field studied, rather than retaining expert knowledge and experience while developing ways to enhance knowledge transfer in interdisciplinarity. Rigidity of discipline expertise is resisted by a curriculum which mandates non-expertise focus and a dynamic environment. While this is appealing conceptually, these approaches have consistently failed on the ground. This approach to expertise appears as well in the literature surrounding knowledge transfer (below), and evidence there suggests this is not the only way to go, it is merely the 'easy' way (Chi and VanLehn 2012; Lobato 2012).

Both automaticity and entrenchment may have implications for the order in which certain things are best learned. While the notion that disciplinary expertise (or competency) should be learned prior to interdisciplinarity may seem 'common sense', and indeed is often treated as such in much of the RoI literature (including some of the IDS literature), there is reason to doubt this based on automaticity. If disciplinary knowledge, skills and methods, and more importantly disciplinary ways of thinking, are learned first these are likely to become relatively fixed points thereafter, and according to the evidence on automaticity quite difficult to dislodge. This notion is also upheld by the comments of several of the medievalists I interviewed, who made mention of the continuing influence of the ways of thinking of their first disciplines, even after many years of interdisciplinary work: in several cases no longer even working within that discipline.

This begins to paint a picture of a pedagogic paradox. Expertise is needed to develop the higher-order thinking that makes interdisciplinarity useful, but developing this first may make interdisciplinary thinking unlikely. *Balancing between entrenched and overgeneralised curricula may be the most important function of well implemented interdisciplinarity.*

Domain Specificity & Knowledge Transfer

Domain specificity is perhaps the most important basic feature of expertise for interdisciplinarity research. The notion is that the enhanced skill and problem-solving abilities of experts become increasingly specific to the domain of study as practice

continues, that this focus eventually becomes quite narrow, and that the skills and enhanced abilities *are not transferable*, even to very similar seeming fields or conditions. "There is little transfer from high-level proficiency in one domain to proficiency in other domains – even when the domains seem, intuitively, very similar" (Feltovich *et al.* 2006: 47). A study by Gobet and Simon (1996) showed that chess masters had no greater ability than novices to recall *randomised* board positions. This suggests that their expertise does not extend to all tasks involving chess pieces and boards, but only to patterns which represented actual play. Similarly, Eisenstadt and Kareev (Feltovich *et al.* 2006: 47) found that masters of the game Go were no better than novices at recognising Gomoku arrangements, even though both are played on the same board and using the same pieces. There have been many more experiments across a fairly wide array of domains which have continued to support the domain specificity feature of expertise (Voss *et al.* 1983; Wineburg 1991; Schunn and Anderson 1999).

For studies of disciplinarity this data is critical. It offers empirical support for functional disciplinarity being deeply embedded in the human learning process, and suggests that *disciplinarity will happen as we become more skilled in areas, whether we want it to or not, as a side-effect of the domain specificity of building expertise.*[66] It is perhaps telling that Chi (2006) chose to list this trait of experts as a hindrance, not a benefit; the domain-specific nature of expertise may be essential for understanding disciplinarity, but it presents a big problem for interdisciplinarity. Quite a few of the most popular models of interdisciplinarity rest on the presumption of transferability between disciplines which seem similar, "Interdisciplinary studies provide an approach in which such skills become habits of mind; they fall naturally out of the interdisciplinary process. Indeed, a host of intellectual skills, sensitivities, and sensibilities valued by educators are developed as by-products of interdisciplinarity" (Thompson-Klein 2004; Repko 2008; Newell *et al.* 2010; Newell 2010: 363).

There is little said in the literature on expertise of the possibility of meta-expertise, or expertise in meta-cognitive skills (e.g. graduate attributes), such as may be domain specific but also extendable across many domains with training (Knight 2001; Barrie and Prosser 2004; Moore 2004; Davies 2006). "The notion of an 'expert generalist' is difficult to capture within the current explanatory systems within expertise studies" (Feltovich *et al.* 2006: 46). Further, the narrow specificity and lack of transfer discussed in most expertise

[66] This concept relates as well to the notion of 'natural' categories, which will be explored in chapter 6

studies has been of high-level domain experts. Little has been said empirically of the domain specificity of novices (i.e. undergraduates), or perhaps more usefully of middling levels of expertise such as postgraduate students (Davies, M. and Devlin, M. 2010: 24).

There is some hope for interdisciplinarity though, in that there appear to be many different functional levels of expertise within and around domains. Shunn and Anderson (1999) conducted a study of expert performance in psychology, "to determine whether there are domain-general procedures that expert scientists from different domains share, but are not found in all educated adults" (343). This was an extension of earlier work by Voss *et al.* (1983) which presented a simpler concept of two levels of expertise, that of doing 'science' and expertise in specific scientific domains (Schunn and Anderson 1999: 342). Schunn and Anderson found that, as expected, only narrowly trained specialists gave the best and most complete answers to questions about their particular specialism of psychology, but on more general psychology questions all psychologists of the same approximate level of training were able to produce consistently better answers than non-psychologists. Further, the more questions became about general science, and not only psychology, the more the gap between the experts and the other participants narrowed.

Notably, in Schunn and Anderson's experiment the category of 'all educated adults' was filled by undergraduate students. This means that in terms of proposing further hierarchical similarities across the 'two cultures' this study is substantially limited: it would need to gauge the responses of *equivalent* levels of expertise in each 'culture' against a set of domain-general academic thinking skills (i.e. graduate attributes and scientific method). Nevertheless, the results which Schunn and Anderson found have broad ranging implications for developing interdisciplinary and domain-general curriculum designs. The findings suggest that although domain specificity is clearly a problem for transfer and interdisciplinarity, that it is functional on many levels at once, in a form of a *hierarchy of expertise*. Schunn and Anderson, and Voss *et al.*, did demonstrate substantial losses of expert knowledge at each step away from the specialist level, but recalling that the scientific method is meant to encompass all academic study, not merely the traditional STEM fields, this hierarchical concept could offer a pedagogic path to greater transferability across *any* field. *If interdisciplinarycurricula could be focused on developing the skill to translate one's own expertise into the common language of the scientific method, this loss might be considerably mitigated.* This could form a core skill of interdisciplinary teaching.

The notion of conceptually 'near' and 'far' disciplines appears in the interdisciplinarity literature periodically as 'broad' and 'narrow' pluralistic types of interdisciplinarity, but they are typically loosely defined and underdetermined (Newell 1992, 1994; Huutoniemi 2010). HTRoI and ERoI interviews consistently show that disciplines which are traditionally or topically 'near' each other appear to be better suited to interdisciplinary activity on a regular basis (individual or collaborative) (Thompson-Klein 1990; Lattuca 2001; Nikitina 2002).[67] Why some structures appear 'near', and therefore more effectively transferable, is not clearly established in a consistent or empirical way that could reliably be used to structure a curriculum around though.

One possible explanation is that 'nearness' is not the best way to consider the issue. Rather I propose that this increase in ease of transfer can be more effectively understood in terms of shared core training, and that this is what Schunn and Anderson and Voss *et al.* have demonstrated. STEM disciplines often share a considerable amount of early undergraduate coursework over many fields, only separating into specialisations in the later years of a degree, and even here there is often overlap across specialism 'groupings' (Gunn and Talbot 2012). This is not common practice in the humanities, though, which could suggest a flaw in the concept. In the humanities, however, there are a number of shared non-disciplinary theories and methods which are taught in each field contextually, such as Marxism or feminist critique, deconstruction, or source criticism. (Thompson-Klein 2005a; Rowland 2006; Moran 2010). These also form a type of shared core of knowledge across these subjects. In practice, the social sciences appear to combine practices of both humanities and the sciences (Becher 1989).

Knowledge Transfer Research

So far we have looked at knowledge transfer seen through expertise research or interdisciplinarity theory, but there is also a more dedicated specialisation of study which looks at the psychology of knowledge transfer itself.[68] The RoI literature is awash with discussion of transfer of knowledge, often regarded as something that occurs naturally as a result of interdisciplinary actions or being in interdisciplinary environments. Knowledge transfer researchers, however, tend to take a different view, one which concurs with expertise research on domain specificity, "Unfortunately, considerable research suggests that the knowledge-to-go served up by schools does not 'go' that far" (Perkins and

[67] Whether or not interviews are the best way to isolate a generic concept of interdisciplinarity, they are surely a reliable source of evidence on the relative perceptions of the difficulty of different tasks by the participants.

[68] Michelene Chi is notable for being a prominent researcher in both expertise and knowledge transfer.

Salomon 2012: 248). In some RoI cases it is suggested that explicit teaching should be offered for students to learn to engage in interdisciplinary knowledge transfer, though it is not clear that this is ever developed into actual curriculum (Repko 2008; MacKinnon *et al.* 2010, 2013).

First though, Perkins and Salomond raise an interesting concern with transfer research, which may have bearing on how we choose to perceive the goal or process of interdisciplinary learning and teaching that there is perhaps terminal ambiguity between when something is transferred knowledge and when it is simply applied knowledge, i.e. where is the demarcating line between an *application* of knowledge to a novel situation, or a *transfer* of knowledge to a novel situation.[69] Followed to its conclusion this may suggest that the goal of interdisciplinary curricula should not be enhancing transfer of knowledge between expertises, but developing a generic skill to allow all knowledge acquired to be applied to all situations without regard for notions of disciplinarity. This is typically the goal of most radical transdisciplinary initiatives, but there remains no substantial evidence, from Perkins and Salomond or transdisciplinarity proponents, that such a broadly applicable skill exists or could be learned by humans.

There may be a positive approach to this notion in terms of interdisciplinary curricula though. Samuel Day and Robert Goldstone demonstrated this unrecognised transfer of ordinary application in an experiment using computer tasks (Day and Goldstone 2012). Most respondents failed to realise any transfer had taken place. It is conceivable that with weakened concepts of disciplinary ownership and an increased interdisciplinary curriculum, that this simple task of cross disciplinary application of knowledge could become more commonplace. There remains a clear potential for such a perspective to devolve into non-expertise or abstracted models of transfer though. A curriculum designed around these ideas would need to take this into consideration. The two are opposite sides of a single balance of educational agenda; educating for expert skill in a specific field and educating for a generic ability to function in many situations.

Transfer research often considers curriculum or pedagogy, at least in a general sense, because the notion of improving transfer is typically assumed to be related to the quality or type of instruction happening. Several approaches have suggested avoiding a deep structure understanding of knowledge, and instead that knowledge transfer is best

[69] This returns to the previously discussed Pure versus Applied debate of disciplinary classification.

approached by trimming off the unique traits or contextual elements: transfer by abstraction. There is considerable empirical evidence for this being successful (Dane 2010; Day and Goldstone 2012). This is the core agenda of competency interdisciplinarity. But although transfer may occur to a greater total degree in the sense that more of it is happening, in the sense that depth and nuance of the initial knowledge is actually transferred it does not happen at all (this is typically confirmed empirically in the same studies). "It is as if the lowest common denominator is sought in order to reach consensus, rather than facing the challenges of the disciplinary difference" (Rowland 2006: 95). Such a situation, if it is applied to developing interdisciplinary expertise in higher education, could easily make the resulting transfer ineffectual or even dangerous.[70]

If transferring *expert* knowledge is to be the goal of interdisciplinary learning and teaching in higher education a different approach is needed. Joanne Lobato offers a method of actor-oriented transfer (AOT) based on the studies of J.F. Wagner (Wagner 2006, 2010) that seeks to both develop and *grow* contextual nuance as an aspect of transfer, thus increasing the nuance and depth of the transferred knowledge in each case, rather then further abstracting it which would lead to eventual surface comparisons (2012: 243). This approach has significant ties to personal epistemology, though this connection has not been made. Lobato proposes that transfer between tasks or subjects *of some kind* always occurs in students, it is just not the kind we want in most cases, and can sometimes even be detrimental to future learning. Lobato shows that the mechanism which determines which kind of transfer occurs is based on a combination of contextual elements (situated learning), prior knowledge and beliefs about knowledge (personal epistemology), and instruction. The solution Lobato implies is to direct the curriculum to building links to contextual and prior knowledge in an expanding web of interconnections, rather than trimming context and personal aspects to abstract the knowledge and remove nuanced expertise from it (Lobato 2012: 243).

Failure of knowledge transfer is another big concern in the literature, something that is scarcely encountered as a possibility in the literature on interdisciplinarity. Typically in transfer studies one or another explanation for the failure to *connect* ideas is explored, but Michelene Chi and Kurt VanLehn (2012) took a different approach to understanding the problem: that the failure was not in transferring, but in having not learned the knowledge

[70] Dangerous in the sense of the potential overconfidence, which the presumption of expertise can develop. If transferred knowledge is missing essential nuance, but expertise is presumed regardless, this could lead to dangerous conditions in many fields.

effectively in the first place. Chi and VanLehn showed that both experts and novices could identify relevant surface features in a transfer situation, but that experts made much fewer extra or irrelevant identifications. They propose that this is due to the experts having the relevant deep structure knowledge to see the *interactions* between the surface features, and thereby quicker identify the relevant ones and not waste time on irrelevant ones (181).[71] When they examined the reasons for the choices each group made, there were no matches in the thought processes. Novices only looked at the surface features themselves, and recognised ones they had most encountered in similar situations (i.e. they recognised genre patterns), while experts mentioned the meaningful patterns of relationships between the surface traits. Chi and VanLehn recommend a pedagogic approach which focuses explicitly on developing the deep structure knowledge in each isolated example/lesson that might be required to recognise the transferable interactions between surface features across domains (183). For example, in situations dealing with measurement in different environments students should be explicitly instructed to consider the *relationship* between length and width in order to apply the concept of area to dissimilar cases.

This could have a profound effect on the approach to interdisciplinary curriculum design, as it suggests that focusing disciplinary and deep structure explicitness and clarity may be more important for facilitating interdisciplinarity than breadth or number of disciplines covered (i.e. interdisciplinarity might be better learned from within deep immersion in two or perhaps even only one discipline, than learning surface features across many).[72] Drawing on Chi and VanLehn's findings, deeper understanding may actually facilitate broader and more nuanced interpretation of categorical similarities between interdisciplinary elements.[73] Conversely, if a bit of knowledge is only understood on a surface level, then only surface level sameness can be categorically compared to anything else.[74] It is also reasonable to expect false-positives at this surface level (apparent transfer wherein deep similarities don't really exist), and that there is likely to be very little transformative transfer or genuine integration of knowledge in either direction. The solitary undergraduate interdisciplinarian of IDS programmes is such a case, but this issue can translate into poorly constructed collaborative interdisciplinarity as well. *This suggests that*

[71] This relates strongly to the notion of causal categorisation as an advanced feature of categorising as well. See chapter 6.
[72] This brings to the foreground the often unaddressed question of interdisciplinarity as knowledge of several disciplines or interdisciplinarity as the skill to integrate knowledge, though both concepts do still imply a solitary practitioner which is itself debateable.
[73] This is one reason for the decision to look in more detail at the psychology of categorisation in the next chapter.
[74] Categorical similarity is discussed in more detail in chapter 6

pedagogic development of deep knowledge structures may be essential to integrative transfer and therefore to effective interdisciplinarity.

Time, Trust, and Qualification Frameworks

One thing above all, be it constructed or objective, that our best efforts do nothing to mitigate the practical truth of is time. Financial, human and other resources can be negotiated. The situated environment of learning can be rebuilt or recontextualised. The value and means of truth and knowledge can be re-written entirely from one culture to the next. But no culture, context, or resource allocation has shown any capacity to alter the one constant that is time. IDS programmes, thematic university restructuring and many other interdisciplinary models profess to be able to develop some form of interdisciplinary result within a specific span of time, typically the three to four years of the undergraduate.

"…only interdisciplinary studies can integrate what insights the various disciplines have to offer in the most comprehensive understanding currently possible" (Newell 2010: 363). This is a huge claim, and should have big evidence to support it, but there appears to be very little of this evidence available. Instead closures of IDS programmes in increasing numbers have been well documented in the pages of recent HTRoI literature. The three flagship IDS programmes of the early days of the AIS, for example, have all recently been closed, along with a string of other such programmes (Newell 2010; Thompson-Klein 2010b; Wexler 2012).[75] Further, experimental interdisciplinary universities like Murdoch have returned to disciplinary focused curricula, keeping only an ethos of promoting interdisciplinarity in students, and the University of Melbourne has returned to a more discipline based curriculum, with only 25 units of the curriculum now mandated to out of discipline coursework (Marshall 2010; University of Melbourne 2010; King 2011). Speculations on the causes have varied. William Newell suggests that IDS may be evolving into a more widely accepted approach to general education, and that 'ironically' the originally programmes are now obsolete.[76] Most other authors have not been so optimistic though, citing administrative bean-counting, narrow vision of funding bodies, 'institutional pushes against innovation', overt disciplinary hegemony, or even the concept of academic standards itself (in a distinctively negative sense) as the cause (Henry 2005; Thompson-Klein 2010b; Wexler 2012). A different possibility though is that these

[75] Wesleyan University (Thompson-Klein), University of Miami, Western College (Newell), Appalachian State College

[76] There may be some truth to this analysis, but Newell appears to take the notion too far by suggesting IDS as the new face of university education.

programmes do not offer any consistent example of a recognised national or international qualification: they do nothing to engender trust in the abilities of their graduates. A steady feature in RoI on effective interdisciplinary *collaborations* is the degree of trust and mutual respect team members need to have in each other's expertise (Lattuca 2001; Lyall and Tait 2001; Bruce *et al.* 2004; Thompson-Klein 2005a; Boix Mansilla 2006; Spelt *et al.* 2009). Trust in the abilities of others is useful in a general sense as well though. A degree or certification confers a recognised judgement of trustworthiness to a certain level in a certain area of knowledge or skill. Qualification frameworks extend beyond these to attempt standardisation of the criteria for degrees across all or many subjects, and furthermore extend beyond a single department to institutional, national and more recently international scope (QAA Scotland 2012; Ministry of Science Technology and Innovation 2005; OECD 2012):

> "The development of subject benchmark statements was one of a set of linked recommendations of the National Committee of Inquiry into Higher Education Report of 1997 (commonly referred to as the Dearing Report). Together with the development of national qualification frameworks, programme specifications, and a code of practice for the assurance of quality and standards, subject benchmark statements were seen as a means of making more explicit the nature and level of academic standards in higher education and, in turn, providing a foundation for students, employers and others to have confidence in the academic awards of higher education institutions" (QAA Scotland 2012: 2).

What these have in common is the intention to signify an amount of reliable trust which should be placed in the expertise of the person who holds the degree or certificate, or who meets the qualification standards. It is also in the degree of trustworthiness of expertise that competency interdisciplinarity, especially in its institutional form as IDS and thematic university structures, demonstrates its most profound problems, due to the extreme inconsistency between programmes: there is no standard.

Qualifications are also a substantial marker of the emergence of new disciplines. Benchmarking a field of study requires considerable time and money, as well as prolonged consultation with field experts, which also means there must be enough of these to justify doing so (Szostak 2008; Hjørland 2008; QAA Scotland 2012; OECD 2012). When completed, however, benchmarks express a broad (though often generic and somewhat flexible) consensus of recognition of a field at the national or international level.

As stated above, proponents of competency interdisciplinarity have often criticised qualifications as an inherently negative neo-liberal form of control. Non-rhetorical justifications for these criticisms, however, are not given. While qualification standards surely can be a source of exclusionary or elitist control, they can also be a source of egalitarian and emancipatory development: the distinction being how they are developed and by whom. Standards based on demonstrable skill and the scientific method for example are inherently egalitarian.[77] Standards based on a transparent democratic ethos and peer-review are inherently emancipatory.[78] The Scottish Credit and Qualification Framework (SCQF), for example, considers social mobility one of the chief reasons for qualifications:

> "**Why does Scotland need a framework of levels and credits?**
> There are many different qualifications - for example, Standard Grades, Highers, SVQs, HNC/Ds and Degrees - and the Framework is a way of showing how they relate to one another. It shows that qualifications are broadly comparable, but it does not mean they are equal. The SCQF supports the Scottish Government's lifelong learning strategy and - now that there's more mobility of learners and workers across the UK, Europe and internationally - *qualifications frameworks are the method by which learning will be understood globally*" (SCQF 2014).

My argument is not that standards are *never* used to exclude some views or to exert hegemony for its own sake. Rather that this represents bad practice, not bad theory and method, and that the resolution lies outside of the question of disciplinarity and interdisciplinarity but is a matter of separate studies of educational politics and moral philosophy.

Developing Standards

There is no apparent dispute in the literature that what particular skills/traits we choose to assign to a particular level of expertise qualification is intersubjectively constructed. This is not the same, however, as suggesting that it does not or cannot have an empirical basis, or that such qualifications are merely relative such that some standards cannot be shown better than others. In the earlier days of guilds and medieval universities such standards could be established entirely by 'masters'

[77] This is based on the notion that demonstration of skill is relatively objective, and as Kimball noted the scientific method can be learned and used by anyone.
[78] Peer review and democratic ethos being the principle that control is distributed and egalitarian. This does not presume in either case that the egalitarian or emancipatory efforts are likely to be perfect, or that there are not substantial other social factors involved in a process as complex as higher education. My assertion is only that the principle of such efforts is egalitarian and emancipatory; the degree of success is then dependent on the quality of each process.

within a particular guild or university, a circular system which clearly did have a high potential for abuse. But the process of benchmarking and developing frameworks has moved on substantially since then, to become a largely transparent, regulated, and nationally and internationally distributed network of systems.

The development of a qualification standard, be it for a single course, an undergraduate programme, or a complete international system is not based on whim, but on collected experience and in many cases extensive empirical data collection as well. The General Dental Council (GDC), for example, is a group of professionally acknowledged dentistry experts who deliberate extensively before publishing a detailed account of the skills that a new dentist must exhibit to claim that title (Bissell 2012; General Dental Council 2013). Similar professional bodies of experts exist to develop standards in many fields where substantial risk to humans or the environment are present, such as medicine, or electrical engineering (General Medical Council n.d.; IEEE 2014).

Similar benchmarks are developed for all broadly recognised HE fields, often first at the national level, via organisations dedicated to this task. In Scotland this is represented by the joint efforts of the Quality Assurance Agency (QAA) and the Scottish Credit and Qualifications Framework (SCQF) group. The QAA works extensively with field experts (and professional accrediting bodies such as GDC) across the sector to develop comprehensive subject benchmarks. The SCQF establishes the national qualifications framework. The latter develops a generic structure of what approximate amount of expertise should be expected of a graduate at each level of further or higher education in Scotland *in any subject*. The former establishes the specific benchmarks of skill and knowledge that correspond to the SCQF levels in each subject individually. Combined, these are then coordinated with wider international qualifications frameworks:

> “A working group was convened in 2006 by QAA Scotland and Universities Scotland to verify, against criteria stipulated in the 'Bologna Process' in higher education, that the framework for qualifications of higher education institutions in Scotland is compatible with the framework for the European Higher Education Area (EHEA). The Scottish working group consisted of experts from the sector, students and international representatives, and progressed the verification process through SACCA under the auspices of the QAA Scotland Committee. The final report on the verification process was approved by the QAA Scotland Committee, and subsequently submitted to the Bologna working group on qualifications frameworks. It is hoped that

> the Scottish verification report can inform the verification procedures in the remainder of the countries signed up to the Bologna process, each nation having a target date of 2010 to verify that their national frameworks are compatible with the framework for the EHEA" (QAA 2006: 4).

Structure of Qualifications

A consistent consensus in expertise research is that it takes approximately ten years to reach expert levels in any field (Ericsson 2005; Feltovich *et al.* 2006; Dane 2010). In terms of the academic disciplines the three to four years that an undergraduate spends in study is not sufficient for this. The title 'expert', however, is usually reserved only for those who hold a PhD or equivalent, and this does take nearly a decade to achieve (six years minimum if in England and not taking a masters, but eight years more commonly, ten if including two years of post-doctoral work, which is often expected on job postings). Effectively this says that the undergraduate degree is not a qualification to practice *as an expert* in a field, but rather completion of the novitiate stage and readiness to advance to further training. This is an important consideration for interdisciplinary curricula, because it means only a certain degree of expertise is expected. Acknowledgement that 'expert' status is not expected at the undergraduate level appears to be one source of some of the rationale for competency interdisciplinarity. Novice level expertise is not, however, simply an unqualified concept with no standards or bounds. It is important to be able to have trust in the skills of graduates, especially in the globalised world we now live in where mobility makes personal knowledge of the skills of others less likely.

To understand how qualification frameworks intersect with interdisciplinarity it will be helpful to take a brief look at the origins of the most common markers of expertise. Several expertise researchers have addressed the problem of identifying expertise levels in some effective way while allowing for the vicissitudes of social construction, the most notable being Dreyfus and Dreyfus (1980) and Hoffman (1998 cited in Chi 2006: 22). Perhaps surprisingly, these studies have not presented entirely novel models for classifying expertise, rather they have revived and refined the medieval European guild model: novice, initiate, apprentice, journeyman, expert, and finally master. Table 4.1 shows the guild-based levels and the descriptors as given by Hoffman. I have paired these with the approximately equivalent expertise titles common to higher education.

Guild Title	Description (Hoffman 1998)	Academic Title (approximate)	SCQF Level
Novice	Literally, someone who is new – a probationary member. There has been some minimal exposure to the domain	High school graduate, A Level	6
Initiate	Literally, a novice who has been through an initiation ceremony and has begun introductory instruction	Undergraduate (Pre-Honours)	7/8
Apprentice	Literally, one who is learning – a student undergoing a program of instruction beyond the introductory level.	Undergraduate (Honours)	9/10
Journeyman	Literally a person who can perform a day's labour unsupervised. An experienced and reliable worker, or one who has achieved a level of competence. Despite high levels of motivation it is possible to remain at this proficiency level for life.	Postgraduate	11
Expert	The distinguished or brilliant journeyman, highly regarded by peers, whose judgements are uncommonly accurate and reliable, whose performance shows consummate skill and economy of effort, and who can deal effectively with certain types of rare or 'tough' cases. Also, an expert is one who has special skills or knowledge derived from extensive experience with subdomains.	Doctor	12
Master	Traditionally, a master is any journeyman or expert who is also qualified to teach those at a lower level. Traditionally a master is one of an elite group of experts whose judgements set regulations, standards, or ideals. Also, a master can be that expert who is regarded by other experts as being 'the' expert, or the 'real' expert, especially with regard to sub-domain knowledge.	Professor	

Table 5.1 Guild Expertise (adapted from Hoffman 1998)

Transactive Memory Systems

If developing personal expertise involves developing more efficient chunks and memory patterns to utilise the limited resource of STWM, then perhaps a form of collaborative expertise can do the same for the ubiquitous collaborative form of interdisciplinarity. But there may be complex social constraints on this, and a whole new type of expertise might need to be considered.

> "Interdisciplinary synthesis often takes place in an individual researcher's mind. Yet many contemporary research projects involve so many researchers and disciplines that it is unrealistic to expect all relevant knowledge to be integrated in the cognition of a single individual. In these cases the synthesis takes place in distributed cognition, involving several individuals capable of melding theories, methods, and data from different disciplines. We know very little about the cognitive processes of knowledge integration, be they at the individual level or distributed among several individuals" (Huutoniemi, *et al.* 2010a: 86).

The quote above is half right; much (perhaps most) interdisciplinary activity is indeed occurring in groups.[79] What Huutoniemi *et al.* have missed, however, is the rich field of

[79] I will later argue that it should *only* be perceived to occur in groups if we want to ever build effective currcula and processes around it

research on the psychology/sociology of team cognition and group expertise thriving since at least 1985 (Lewis and Herndon 2011: 1254). We know quite a lot about 'the cognitive processes of knowledge integration' in fact, but this has not been coordinated with work on interdisciplinarity. The research that has been done comes in two forms that are of specific interest here: Transactive Memory Systems (TMS) and expert teams. These concepts are very similar, but have been developed and researched separately from each other. There is more research on the former than the latter.

A Transactive Memory System is a specialised form of group-based distributed knowledge and memory construction, one that exceeds simple group work in much the way expertise exceeds novice abilities.

> "A transactive memory system (TMS) is the shared division of cognitive labor with respect to encoding, storage, retrieval, and communication of information from different domains that often develop in close relationships" (Lewis and Herndon 2011: 1254).[80]

In a simple group environment each member works to develop as much *personal* knowledge of the collective pool of shared knowledge of all members as they need to resolve the project. This can take a long time replicating and sharing information, may cause considerable overlapping knowledge, and can lead to substantial confusion based on non-expert interpretations and miscommunications. Both problems are among the most widely cited issues facing interdisciplinary projects in the RoIR literature and beyond (Lyall and Tait 2001; Bruce *et al.* 2004; Thompson-Klein 2005b; Griffin *et al.* 2006; Huutoniemi 2012). In a TMS, however, members of the group work to develop a more efficient and less error prone shared knowledge of what skills and knowledge each other possesses in relation to their own, and learn to call on these like a phonebook or Google search.[81] The distinction is analogous to the difference between a novice who must explain a complex concept in great detail, and an expert who can convey the same information with a single word or phrase. Members of a TMS do not seek to *understand* what others know themselves; they seek to be aware of how to *access* that understanding.

A TMS can arise spontaneously from well-formed teams, but this can be achieved faster and more consistently via explicit pedagogic development, "...teams that had received

[80] The inclusion of 'develop in close relationships' is suggestive of the tacit concept of 'near' fields again, but in practice this can be taken to mean that the collaborative effort itself has developed in close relationship. This makes this aspect an important pedagogic feature.

[81] In fact the process in individual terms has been referred to as the 'Google Effect', where individuals memorise where information is stored and can be accessed, instead of memorising the information itself (Sparrow *et al.* 2011).

team-skills training in problem solving, interpersonal relationships, goal setting, and role allocation were more likely to develop TMS than were non-trained teams" (Prichard and Ashleigh 2007 cited in Lewis and Herndon 2011: 1255).

Expert teams are a similar notion to TMS, but while research on TMS has arisen from research into the psychology of group work, expert team research has developed out of expertise studies. A typical example is a professional sports team, the best of these being functional as expert in their field *as a team*, while each member is an expert at *being a member of the team*. The notion of an expert team, however, can extend to any field (Salas *et al.* 2006). An expert team of researchers would be a group which works so well together that the combined expertise of the group can be seen as an enhanced *singular* expertise unto itself, while each member is not only expert in their own discipline, but expert in being part of the team.[82] The parallel between expert teams and TMS is clear. Such correlation offers substantial validation of the independent research in each field, and is something not achieved by RoI.

Traits of Transactive Memory

There has been considerable empirical research on TMS, the psychology of how they work, what enhances them, and what any downsides may be. A key benefit of TMS research over RoI is that the bulk of TMS studies include primary or at least secondary empirical tests of whether TMSs actually produce more effective, efficient or desirable results. In RoI this is all but non-existent, and where attempts have been made they remain unconvincing (Lattuca *et al.* 2004). Within this there is a near unanimous consensus that team performance is demonstrably enhanced in TMS situations over both individual work and over ordinary group work as well, which presents a problem for approaches to interdisciplinarity which consider individual and collaborative work to be compatible under the same definition.

Lewis and Herndon (2011) reviewed the empirical findings of 30 years of TMS studies, and offer the following propositions to define TMS and its effectiveness:

- "**Proposition 1A.** *Compared with groups in which group cognition is limited to shared understanding of who knows what, groups with TMS will have higher performance.*

[82] Not unlike a discipline perhaps, though this stretches the credulity of the notion a bit.

- **Proposition 1B.** *The higher performance by groups with a TMS will be attributed to the degree to which the group's knowledge is differentiated, evidenced by the diversity and depth of knowledge possessed by members and applied to the group's task.*

- **Proposition 2A.** *Compared with groups whose members have a shared understanding of who knows what, groups with TMS will demonstrate greater learning.*
- **Proposition 2B.** *This greater learning in groups with a TMS will be attributed to integrations, evidenced by new knowledge that no member had previously possessed"*
  (Lewis and Herndon 2011: 1256-1257).

Propositions 1A and 1B establish that a TMS is not merely a group where the members share an understanding of what the others know about, but also that the knowledge of the group members must be differentiated, that is there *must* be different natures and sources of expertise to make a TMS. Propositions 2A and 2B establish the process of the superior performance exhibited by TMSs. The findings of the TMS research suggest that the increase is due to the differentiated nature of the expertise combined with the shared understanding, which creates integrated knowledge that becomes unique to the group.

Not only is this effectively the same as many definitions of interdisciplinary integration, it also mirrors the claims to 'betterness' found in the HTRoI literature, except that many of the latter refer to solitary competency models. In the case of TMS the claims are backed by empirical studies of actual outcomes.

> "TMSs are thought to improve performance in workgroups because they facilitate quick and coordinated access to specialized expertise, ensuring that a greater amount of high-quality and task-relevant knowledge is brought to bear on collective tasks" (Lewis and Herndon 2011: 1254).

This suggests that the 'betterness' is a result of collaborative work, and only a specifically formulated and developed type at that. The need to both define interdisciplinarity as collaborative and to explicitly develop the skills of TMSs as part of interdisciplinarity seems clear.

Zhang *et al.* (2007) studied what conditions lead to the increased performance in both TMS development and TMS activities, something which could help develop interdisciplinary curriculum models. They found that task interdependence, cooperative goal interdependence and support for innovation were the elements most positively related to

developing good TMS, as well as further confirming that actual group output was also improved by developing as a TMS (Zhang *et al.* 2007: 1723).

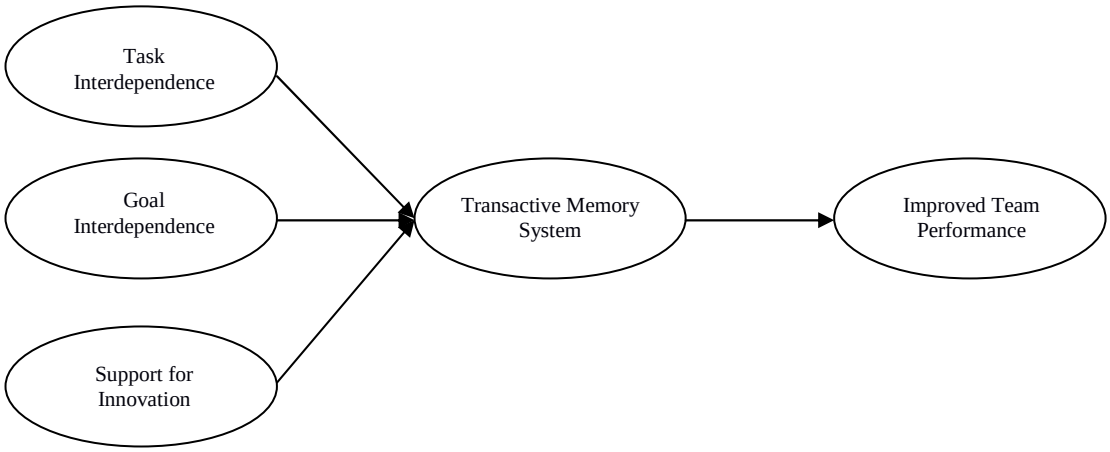

Figure 5.2 Factors of Transactive Memory (Zhang *et al.* 2007: 1723)

Task interdependence refers to the degree to which each member's tasks require information from other members. TMS (or interdisciplinarity) is clearly unnecessary if there is little or no task interdependence, i.e. wherein a single disciplinary solution would suffice. They also found that task interdependence increases as work complexity does, which supports some interdisciplinarity models that consider interdisciplinarity essential due to the complexity of the current knowledge environment or world problems (Gibbons *et al.* 1994; Newell 2001; Thompson-Klein 2001). Cooperative goal interdependence refers to the belief of each member that achieving their own goals aids in achieving the group goal. This was seen to promote the sense of shared purpose and facilitate mutual respect and communication. Again, these are elements commonly identified in the RoI literature, but without the benefit of empirical study they are not differentiable from mutually exclusive claims, nor are pedagogic models apparent.

The third condition Zhang *et al.* list is institutional support for innovation. This translates clearly as a matter of administrative support for interdisciplinarity. Thompson-Klein (2010a) has made considerable claims in this regard to the effect that administrations must make space for interdisciplinary institutes, dual-hire staff, or give staff extra leave for interdisciplinary projects (Thompson-Klein 2010b: chapter 4). This approach ignores pedagogy and the nature of the curriculum itself as a more effective place to locate support for innovation, chiefly in support for models which develop the other two traits of TMS that Zhang *et al.* identified. As noted in the introduction though, this thesis is concerned

more with undergraduate curriculum, and will not look at administration of interdisciplinarity to any great degree.

Two additional apsects of Zhang *et al.*'s study are worth mentioning. First is that the study was conducted in a practice environment, not a laboratory or university student setting, which substantially expands the scope of the findings on TMS in general, making comparisons to interdisciplinarity more viable. The second is that they tested the model they proposed against other models to determine empirically that theirs *best* explained the results (Zhang *et al.* 2007: 1728). This direct engagement with the problem of underdetermination is not seen in the RoI literature.

Interdisciplinarity *is* a Transactive Memory System

Although the literature on TMS almost never refers specifically to interdisciplinarity, it is clear that there is a close relationship between the concepts, TMS is by definition the coordination of different expertises (Wenger *et al.* 1985; Lewis, K. and Herndon, B. 2011: 1256).[83] *In fact it may be correct to say that the best/ideal form of collaborative interdisciplinarity is always a transactive memory system.* A TMS, however, need not always be interdisciplinary, due to the lines we draw between what is a discipline or a specialisation. A TMS requires differentiated expertise, whether or not these are called disciplines, interdisciplines, trades, talents, specialisations, etc. It is possible, for example, to have an effective TMS within the discipline of Archaeology in which each member has a non-overlapping specialisation of archaeology. TMS and interdisciplinarity appear to have a non-reciprocal definitive relationship much like squares and rectangles.

Limitations and the Importance of Pedagogic Solutions

Like expertise, many TMS benefits appear to come at a cost. For example, long-term and well developed TMSs appear to build the same cognitive entrenchment and rigidity sometimes found in individual experts (Skilton and Dooley 2010). If a well-developed TMS is viewed as a functionally singular co-created expert unit, then this should not be surprising. The effects of this can be seen in the evidence that loss of a key individual can cripple such a highly tuned interactive structure (remembering that the power of a TMS lies in each member *not* sharing the expert knowledge of the others) (Lewis and Herndon 2012).

[83] My use of a pluralised form of 'expertise' is intentional here. This is to foreground the notion of a person possesing *an* expertise which, however broad, has limits, as opposed to a more nebulous notion of simply possessing expertise. Recognition of the limits of *an* expertise is essential to the concept of collaboration in TMS and interdisciplinarity, hence seeing these as a collection of 'expertises'.

Considerable effort has also gone into resolving how to balance the efficiency and higher-order output of a TMS with the apparent need for redundancy or other solutions in order to both work well and cope with change. Just as cognitive entrenchment may be mitigated in individuals through meta-cognitive awareness and flexibility training, we might expect TMS development to follow the same pattern, if team development training (or undergraduate interdisciplinarity training) included the same meta-cognitive flexibility. In fact, Lewis *et al.* (2007) found exactly this to be true when explicit training was given to groups displaying obsolete and rigid TMS patterns after the replacement of a key member. Initially the loss crippled groups, who got stuck in entrenched but now obsolete interactions. But when groups were instructed simply to reflect on the effects of the change, the rigidity not only vanished but overall group performance increased.[84]

This suggests that balancing between developing a strong TMS and also cycling in new members periodically may lead, with proper training, to a progressively increasing interdisciplinary output.[85] An effective curriculum around this goal would be essential at the undergraduate level in order to make the most of the longer timeframe and lower levels of entrenchment available there. The links to explicitness in the curriculum as an expedient to developing TMS (and thereby potentially interdisciplinarity) were demonstrated by Lewis's study, and also Prichard and Ashleigh's analysis of the positive correlation between TMS training and performance.

An Alternative Expertise Model?

Lastly in this chapter it is worth reviewing an alternative model of expertise, which does not appear to have much connection to the main field of research on the subject, but which has recently been adopted by some proponents of IDS and competency based interdisciplinarity: the 'interactional expertise' of Harry Collins and David Evans (2007).[86] Interactional expertise refers to a specific range of skills which allow a sociological researcher or journalist to engage in conversation about a field as though they possessed the expertise to perform as an expert, but without having this capacity. The model calls this a fully fledged type of expertise such that in conversation it is empirically impossible to

[84] This also correlates with Chi and VanLehn's (2012) recommendations about explicitly training students to see the underlying features of a problem.
[85] Presumably the increase would level off at some point
[86] Collins and Evan's model is not mentioned in any other accounts of expertise outside of the close circle of Social Studies of Science of which Collins is a pioneering figure. Likewise Collin and Evans make no mention or reference to any other existing research on expertise that would justify that their model is situated within the wider academic understanding of the term.

tell the difference between a practicing expert in a field and an interactional expert who can merely talk about the field. It is largely a misnomer to refer to this as a theory of expertise instead of a theory of communication, but the appeal of such a model for proponents of competency interdisciplinarity is clear. It allows the outward appearance of expertise without requiring the time necessary to develop the expertise in practice (Addis 2013a, 2013b; Doing 2011).

Collins and Evans do not suggest that interactional expertise is a replacement for real skill, but in much the same manner as Foucault's work has been used to validate the negativity of power (although Foucault did not say as much directly), proponents of IDS have suggested that interactional expertise is indeed a valid replacement (Adams 2012: 12). While Collins and Evans' work has clear (and useful) value for validating the degree of theoretical understanding of a field that highly trained journalists and ethnographers can possess after considerable immersion, it has no wider value, and certainly does not validate that competency interdisciplinarity curricula develop real expertise.

Summary

The research on expertise and development of such offers a clue to why it is important to pursue a theory and comprehensive framework of interdisciplinarity instead of trial and error teaching and *post-hoc* evaluations. Both of these are good, but both are also the methods of novice practitioners, not experts. Research of Interdisciplinarity needs to become an expert field.

This chapter has considered the current state of empirical research on the psychology of expertise, including the expertise related fields of knowledge transfer, qualifications and standards and transactive memory systems. The goal throughout has been to relate non-circular and well-formed findings to some of the unresolved problems of disciplinarity and interdisciplinarity. A number of salient ideas about each have emerged from the research so far.

After familiarising with the basics of expertise research it was revealed that expert knowledge is qualitatively superior to novice knowledge in most regards, but that it comes at the price of domain-specificity, entrenchment and an inability to transfer knowledge. Personal epistemology appears to account for some of the negative aspects, such as inflexible thinking and biased thinking. Barbara Hofer suggests there may be pedagogic

ways to develop more flexible personal epistemologies as meta-cognitive skills. Expertise requires automaticity though, in order to develop the high-order decision making and skill of being expert, and automaticity creates entrenched knowledge and lack of transferability.

Competency interdisciplinary proponents suggest that transfer happens automatically as a result of interdisciplinarity. Although expertise and knowledge transfer researchers universally disagree with this statement, several propose a similar solution to entrenchment. There have been several studies to demonstrate that removing expert nuance from knowledge by abstracting it, or more directly resisting developing expertise at all past a point can increase knowledge transfer and flexible thinking. But this comes at a cost as well. The knowledge transferred is surface knowledge only, and prone to errors and redundancy: expertise and the qualitative better and faster decision making that goes with it are lost.

Some have offered other solutions, such as building layers of explicit transfers practice into developing expertise, or focusing on the interconnections between deep structures of expert knowledge. Both are pedagogic solutions, requiring to be implemented as expertise is being formed. This suggests a possible pedagogic solution to developing expert interdisciplinarity, and that it may need to start as undergraduates.

Next we considered measuring expertise, in the form of academic qualifications. Qualifications develop recognisable trust in the abilities of those who hold them, an essential element to collaborative interdisciplinarity according to those doing it. Many of the failures of IDS and other competency programmes appear to be due to a lack of consistent programme goals and coherent qualifications: the expertise they develop is unrecognised and unreliable. Some proponents of competency interdisciplinarity have opposed qualifications on principle as a form of control, but most academic frameworks and benchmarks are transparently developed on rigorous processes of expert analysis.

Finally, this chapter looked at collaborative expertise in the form of transactive memory systems. These are special expert teams which exhibit the same benefits and problems as individual experts, but on a higher level and with additional capabilities. TMSs are also inherently interdisciplinary, in that they require differentiated expertise to achieve results. TMSs also require expert skill, unlike competency interdisciplinarity. Unlike RoI, TMS research has consistently demonstrated that TMSs perform better than individuals and non-TMS teams. Further, TMSs can be trained, there can be a curriculum model for expert

collaborative interdisciplinarity via TMS research. TMSs also display the same problems with entrenchment as individual experts, but being teams with distributed knowledge, this has been shown to be easily corrected by simple training, even producing better results.

The expertise benefits and trust which are desirable versus the cognitive entrenchment inflexibility and lack of transfer this creates presents a ‘paradox of interdisciplinary curricula’. To learn enough expertise for interdisciplinary transfer to be worthwhile typically means having become entrenched, domain-specific and unable to effectively transfer. Fortunately a number of novel solutions have been offered.

Chapter 6: Categorisation

Introduction

Traditionally (meaning throughout the 20th century at least) it has been a dominant assumption that disciplines need to be viewed as separate bodies, and that any discussion of them can start from this basic point. But not only has a small but sometimes popular stream of inter/trans/non/a-disciplinarity literature suggested that disciplinarity and classification of academic knowledge is either unnecessary or undesirable, but recent trends in globalising technologies such as Massive Open Online Courses (MOOCs) could conceivably challenge disciplinary borders by removing delivery of content from established departments.[87] But even without any push to end the division of knowledge, we should still ask how we *know* that we need to be dividing knowledge into sections, and more importantly, is there a *best* way to do so?

At its base the study of categorisation is about answering questions of how and why we make categories, of any kind. Psychological approaches tend to consider categorization as a cognitive, developmental or neurological process, to be tested and explained via complex models and experiment (Danks 2007). It is very similar in nature to the psychological research on expertise, and in fact there is a small amount of cross-over.[88]

The bulk of publication on the psychology of categorisation has been of empirical studies. Most publication is in journals and follows the familiar IMAD format.[89] Collections of essays are also common more recently, and these typically take an overview of the empirical research either to provide a general look at the field, to review the collective evidence for a particular model, or occasionally to speculate on a new model before experiments have been done. I have made a point of looking at both types of publications, though most of the wider insights come from the latter set.

There are three chief areas where categorisation research informs the analysis of interdisciplinarity:

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[87] So far no such case has manifested, and indeed may not.

[88] There is also considerable study under the heading of sociology of categorisation, but this is a quite different field, being concerned with the historical and political development of social categories such as race, class, gender, etc. Although some of this research can and has been linked to interdisciplinarity, it is not the focus of this thesis.

[89] Introduction (literature review), Methods, Analysis, Discussion.

- whether knowledge classification is necessary at all, a fundamental question given the presence of transdisciplinary and non-disciplinary models of knowledge such as ‘mode 2’,
- how are disciplines best distinguished, and are there patterns or reliable trends in categorisation research which can help to understand this,
- how, why, and under what conditions should novel categories such as new disciplines, hybrid disciplines, interdisciplines, fields, studies, etc. be made, and where do they best fit?

As with expertise research, before delving into these questions it is important to lay down the core principles of categorisation research. The next few pages are devoted to this.

Core Principles of Categorisation

Supervised and Unsupervised Categorisation

One of the most fundamental and most widely agreed upon aspects of categorisation is the distinction between supervised and unsupervised categorising. Although extensive research has been done to understand the mechanism and principles of each, the concept is simple. Unsupervised categorisation is any creation of categories or classification of things into existing categories that a person can perform without aid, specifically aid in the form of instruction and feedback (Pothos *et al.* 2011b, 2011a; Sagi *et al.* 2012). Supervised categorisation is creation of categories or classification which is done via training and feedback. Unsupervised categorisation further refers to categorisation which is spontaneous, self-directed, or ‘natural’. This normally implies that an individual is forming new categories from new input. If there are existing categories these are likely to have come previously from supervised categorisation, or even if unsupervised, they are likely to have been intersubjectively or experimentally confirmed since and therefore have an element of supervision as well.

It should be clear that prior experience plays a large role in this part of categorising, and that after time it can become very difficult indeed to isolate purely unsupervised categorisation from categorisation which is at least partially based on existing supervised categorisation. Novel *supervised* categorisation is easier to isolate, as this requires active feedback and teaching of the new categories.

Selective Attention

The core notion of how we categorise, prior to any discussion of what models or methods we use to do it, is that we must as humans selectively ignore some aspects of things in the world. Something that is considered essential for all categorisation is that it requires selection or differentiation of some kind (Medin *et al.* 1997; Rehder 2003; Kruschke 2011; Pothos *et al.* 2011a). If we can ever perceive that more than one experience occurs in time, it is because we have the capacity to say they are not the same occurrence (Kant 2012). If that is the case, then it is in a different category as the other experience, even if that is merely 'this one happened first, that one happened second'. As noted in the previous chapter we do appear to be subject to time, the differentiated nature of which we exhibit no ability to pragmatically refute, therefore we cannot be conscious and aware and fail to categorise (Harnad 2005). This is normally expressed in terms of selective attention; that those aspects of a thing which are considered by a person to be critical for categorising it are those which receive attention.[90] The unavoidable side-effect of this notion is that some things do not receive attention.

This may seem like an obvious statement such that it hardly need be mentioned. Of course we can't pay attention to everything all at once, but this apparent obviousness can lead to dismissal of the underlying importance of holding onto the idea (in a way similar to the 4 foils of pragmatism), and this, I believe, leads to many problems with 'unity of knowledge models' such as 'mode 2' and others. There are further questions derived from this simple concept which are critical to understanding knowledge differentiation and interdisciplinarity such as:

- how many things can humans pay attention to simultaneously (which seems likely to invoke Miller's Law),
- to what extent do conceptual or perceptual similarities between things matter,
- what role does prior experience play,
- what role does subject expertise play,
- is selective attention irrevocably unconscious or can we explicitly learn to be better at this and to use more efficient models (i.e. is there 'expertise' at attentiveness)?

[90] What is considered critical for categorising could be anything from a structured taxonomy to whatever we first notice.

Simplicity, Similarity and Typicality

Moving up from the notion of selective attention we get to the most basic of the models for how conscious categorising takes place. This is known as the simplicity model, and it is almost universally regarded as valid in the literature, though there is considerable discussion of the details and reach of the model (Danks 2007; Pothos *et al.* 2011a; Sagi *et al.* 2012). Essentially the simplicity model says nothing more profound than that we place things in categories when the average similarity of things within the group is greater than the average similarity of things between groups with regards to the features we are attentionally focused on. What is or is not similar to different people in different situations then becomes of great concern to researchers, because although the basic principle of the simplicity model is not much contested, how it actually manifests in practice is much more complicated. In categorisation research within-group similarity is referred to as 'typicality', denoting qualities which are typical of members of that category. This is similar to the statistical concept of 'central tendency', being the range within which the overwhelming majority of results fall. The connection also to Wittgenstein's 'family resemblances' has not gone unnoticed (Lakoff 1987: 12; Pothos and Wills 2011). The core question remains, 'how do we determine which things are more or less like each other?' This same question is also at the heart of determining periodicity in history: how do we distinguish one period of history from another, what features make a point in time more medieval, more antique or more modern? How different medievalists responded to this question was an integral aspect of my interviews, which I will return to in chapter 7.

The principle of typicality/similarity lies at the core of understanding pluralist models of interdisciplinarity, as well as considering collaborative and solitary interdisciplinarity to be the same broader concept. Pluralism proposes many different interdisciplinarities by suggesting that the within-group similarities of each discreet type are greater than the between-group similarities to a single type, which would otherwise suggest a single definition for interdisciplinarity. Conversely, considering both solitary and collaborative interdisciplinarity to be part of the same category suggests that the within-group similarity of the single concept of interdisciplinarity that covers both approaches is greater than the between-group dissimilarities of solitary practice and collaborative practice. I do not believe either of these claims is well justified in the literature.

Models of Categorisation

How we actually develop and differentiate categories from the core cognitive features above is where the bulk of research in the field has been focused. Pothos and Wills (2011)

not only include chapters on at least twelve different models in their edited collection *Formal Approaches to Categorization*, but they also list nine more which they have not included but which are also influential in the field (2011: 1). It may appear that this would support the pluralistic nature of several approaches to interdisciplinarity: that if there is so little agreement on the nature of categorisation this may be because there are a variety of equally valid types. The appearance of disunity is misleading though.

The difference between this 'letting a thousand flowers bloom' approach and the type of pluralism present in the RoI literature is that in categorisation research each of these models is a single self-contained model which represents analytical structures to explain *details* of one or more of three widely accepted 'core models' of categorisation, themselves not seen as incommensurable but rather as complementary and inter-related to each other (Danks 2007). Each new model can be tested and compared with others in isolation, and can be disregarded without throwing the baby out with the bathwater. In RoI, however, entire pluralistic structures are the models, and are considered holistic and indivisible (in the Quinean sense as discussed in chapter 2). That is each new model is itself a plurality, and although a very general core definition of interdisciplinarity may remain similar, the models are typically incommensurable or are meant to be.[91]

Briefly, the three 'core models' of categorisation are Exemplar, Prototype and Causal. Exemplar categorisation involves the individual mentally comparing a new stimulus to a series of actual examples of other things to determine which are more similar. If nothing is very similar a new category may emerge (Nosofosky 2011). Prototype categorisation involves comparing new information to an abstracted ideal mental model of the category derived from many different examples, which represents the aggregate features of these (Minda and Smith 2011). This can be significantly faster than direct comparison to each real example of something which our memory holds, but clearly it can also lead to oversimplification by reducing attentional selection to idealised traits which may not represent any one actual example. This was the revelation of Wittgenstein's 'family resemblances', that all members of a category can be related without there being any single trait which all members have. This oversimplification may help explain some of the overconfidence and missing surface features problems with experts as well. *A faster, more effective categorisation model could be more stereotype than prototype in some cases,*

[91] Some more recent efforts have attempted to assimilate other pluralistic models, but with limited success (Huutoniemi *et al.* 2012).

leading to more apparent expertise than real expertise.[92] Most categorisation theorists hold that we actually use a combination of these, depending very much on the situation and our prior experience (Pothos and Wills 2011).

The third model, causal categorisation, has been proposed more recently by Bob Rehder (2003). Causal categorisation involves creating or placing things into categories based on cause and effect relations between them and existing members of various groups. This can mean either adding a new thing to a group because it shares a causal link to an existing member, or adding it to a relational group of 'caused by' or 'cause of' the main group. In essentialist views of interdisciplinarity, hybrid disciplines would be a good example of a new category formed in a many-to-one 'caused by' relationship to the cognate fields. As research on this model is relatively new, there are still many open questions. It is not yet clear whether causal categorisation supersedes or supplements the other two models, or whether it applies only in certain cases, where causality can be determined, and otherwise we default to the other methods (Hayes and Rehder 2012).[93]

There is speculation and some research findings to support the idea that all three models may be developmentally sequential and active also in most people concurrently (Hayes and Rehder 2012). This suggests that we begin with the most basic and least cognitively stressful type, exemplar categorisation, then rather quickly we progress to being able to generate and apply prototypes, and finally we appear to develop causal categorisation abilities, which become more complex with age as well. Hayes and Rehder recently demonstrated that five to six year olds appear to be able to make simple causal categorisations by determining whether the expected cause or effect is present, but from around age nine upwards we increasingly rely instead on causal *coherence* - whether both cause and effect are present or missing together (Hayes and Rehder 2012). Causal categorisation is presumed to be the most complex and the most mentally taxing (but also the most nuanced), and thus develops latest. This is also a form of categorisation that has been related to the development of expert reasoning (Rottman *et al.* 2012).

Rottman *et al.*'s study is important because it effectively confirms the findings on deep structure knowledge leading to better transfer found by Chi and VanLehn (2012), but from the direction of causal categorisation research. The study tested whether expert students in

[92] This was one of the chief reasons that Ericsson insisted on demonstrable expertise over self-reported, and why I am looking for the same in terms of interdisciplinarity.
[93] Interestingly, the specific nature of unity and differentiation between these models in the research suggests to me a potential similar unity of postmodernism, empiricism and hermeneutics.

the physical sciences could make connections between concepts and situations outside of their domain focus better than novices if there were similar causal links between the concepts to ones they were familiar within in their fields. Rottman *et al.* found that experts did indeed show an ability to transfer concepts or recognise similar situations outside of their expert fields if the causal connections were similar, just as Chi and VanLehn found that transfer occurred much quicker and better in experts who had the deep structure knowledge to see interactions (possibly causal connections) between surface details. Not only does this further suggest that deep expertise must be developed for good interdisciplinary thinking, it suggests that this may also be a route to mitigating domain specificity without resisting expertise as Dane (2010) and others have suggested.

Limitations of Current Research

Recently D.L. Medin produced a short analysis of the state of methodologies and foci within the field addressing what he saw as several on-going shortcomings (based on a review of work in the field since 1980). It is important to review Medin's concerns both because they provide some contextual limits on how far to take evidence from categorisation research, but also because several of Medin's concerns are similar to my own concerns with the RoI literature (I have excluded some technical elements of the list):[94]

> "1. Although concepts serve multiple functions (categorization, inference, communication, etc.) virtually all attention was directed at the categorization function of concepts.
>
> 2. Although there was a body of work on natural language concepts and a body on artificially created concepts...and similar empirical results, the two literatures had little, if anything, to say to each other.
>
> 3. Almost all the adult research was conducted with undergraduate students at major universities.
>
> 4. Almost all of the adult research used tasks that could be completed within an hour and nearly always involved exactly two categories.
>
> 5. Virtually all of the empirical work was on supervised categorization.
>
> 6. The models of categorization focused primarily on predicting transfer performance to a new stimuli given after a category training period.
>
> 7. The stimuli themselves tended to be visual figures having little meaning or relevance to research participants.

[94] Similar concerns have been voiced as well from within TMS and expertise research from time to time.

> 8. The representation of the stimuli was assumed to be fixed and subject only to attentional weighting...Furthermore, the constituent features or dimensions were assumed to be independent and relational properties were ignored...
>
> 9. There was relatively little categorization research in the cognitive neurosciences..."(Medin 2011: 236).

This suggests that my concerns with the RoI field are not entirely unique, and may even be common to most specialised or disciplinary research. Medin also suggested the need for more direct connection between categorisation and expertise research.

Categorisation and Interdisciplinarity

The 'Tree Study'

I will consider several studies below, but one by Medin *et al.* (1997) bears a bit of introduction as it is complex and it suggests links between several elements of this thesis at once. The study was designed to see whether different types of expertise led to different categorisation schemes, and why. To test this Medin *et al.* used different types of tree experts, each with notably different utilitarian applications of tree categorisation:

> "Participants fall into three broad groups: taxonomists, landscapers, and maintenance workers. Taxonomists are principally engaged in research, teaching, and other educational activities. Landscape workers focus on design, aesthetic, and utilitarian aspects of trees. Maintenance workers focus on planting, pruning, and generally maintaining city trees" (Medin *et al.* 1997: 55).[95]

The researchers noted that these categories were neither perfect nor mutually exclusive, but represent a continuum of tree expertise types.[96]

Two experiments were conducted. The first considered what categories of trees each group created spontaneously, and their reasons. Each group was asked to "put together the trees

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[95] The use of tree experts is compelling for categorisation research, like chess for expertise studies, because it allows for study of distinct groups who converge on the same activity in different ways. Also because tree categorisation is not, in most cases, already steeped in social and political rhetoric and debate. Inter/disciplinarity does not share this trait, being integral to the identity and economy of individuals, institutions and even nations. As with expertise research, there are apparent correlations between this study and disciplinarity, but we must keep an eye on the degree of difference as well.

[96] Another notable aspect of the study, which conforms to other research on expertise, is that considerable expertise on the subject had to be developed by the researchers in order to conduct the study effectively and interpret the results. In the study of disciplines this has been noted as well by Shopkow *et al.* (2013), that to consider expertise in different disciplines they would first have to acquire enough expertise to do so effectively (this is perhaps a useful application of Collins and Evans' 'interactional expertise').

that go together by nature into as many different groups as you'd like" (Medin. 2011: 57). Then participants were asked to collate these into as many higher order groups as desired, and to split the initial groups into as many sub-group as desired. Participants were not asked to categorise trees they did not recognise. The common textbook taxonomy of trees formed the baseline against which each group's categories were gauged. Categories were deemed 'scientific-taxonomies' if they conformed to the textbook taxonomy, and 'folk-taxonomies' if they diverged substantially. The results were consistent and reliable for each group. "Taxonomists tended to produce taxonomies which were both broad and deep...In general maintenance workers' taxonomies were broad but shallow...[landscape personnel's] taxonomies tended to be narrow but deep" (Medin *et al.* 1997: 90).

The second experiment considered whether the groups used the same or different reasoning as in the first experiment for categorising new information. Each group was shown a triad of cards where one was a tree with a 'novel' property, and they were asked to say which of the other two it best classified with. The results suggest a great deal of things about how interdisciplinarity has been handled, especially in terms of relative levels of expertise. These will be considered over the next few pages.[97]

Natural Categories - Optimal Categories

Much of the work on the psychology of categorization not only suggests that some aspects of human categorisation are innate/automatic (such as colour vision) but also that nature really does exist in some degree of universal or 'optimal' categories (Medin *et al.* 1997; Harnad 2005; Hayes and Rehder 2012).

> "The notion of a privileged level can be thought of in absolute or in relative terms. If a level is *absolutely* privileged, then categories at that level should be extremely salient, virtually ''crying out to be named'' (Berlin, 1992, p. 53). Such categories might well figure into other, special-purpose taxonomies as primitives and would seldom if ever be broken up. Alternatively, a level might be *relatively* privileged, in that categories at a given level are more likely to appear across subjects, are more inductively powerful, and are more coherent than categories at other levels, but are not

[97] In a sorely under-represented piece on the nature of interdisciplinarity, Rainer Bromme (2000) relates a very similar set of studies he has conducted with chemists (130). In a first test chemists of various types were asked to categorise acids by which were more typical as a common example of an acid (which represented the 'prototype'). There was substantial agreement on several acids, but not so on many more. Some were more typical than others. In the second study Bromme asked them to categorise again, but this time imagining they were doing so for a teaching environment. Again there were consistent patterns, but based on the application the categories were different. This study not only corroborates with Medin *et al.* (1997) on goal-driven categorisation and optimal categories, but also with Schunn and Anderson's finding on hierarchies of practical expertise.

> reified or universal to the extent that absolute privilege would imply" (Medin *et al.* 1997: 51).

Whether this is due to nature occurring in, "strikingly discontinuous bundles that impose themselves on human cognition", or there are "universal cognitive tendencies" that predispose us to see certain categories is less clear (Medin *et al.* 1997: 50, 91). Nature in this case is not personified and does not make 'decisions' about categories as such, rather humans appear to be able to reach strong consensus about some categories without aid or much disagreement. I would argue that disciplinarity likely falls into the second type here, a relatively privileged category. This would suggest that disciplines are not likely to be unsupervised optimal categories, but that they may very well be *supervised* optimal categories, i.e. intersubjectively optimal, not subjectively optimal. I will refer to these concepts as 'optimal' categories henceforth, rather than 'natural' as this can be a contested term.

Results in the second part of the 'tree study' supported that the scientific *genus* level category was privileged by all groups: it was optimal.[98] Participants matched new trees increasingly and consistently towards their own folk-taxonomies if a match to the scientific taxonomy was not apparent at the *genus* level. That is, the further from the base or 'optimal' category a classification became, the more they used their own folk-taxonomies instead of the scientific one. Relating this to expertise and interdisciplinarity, it suggests that the more nuanced or specialist a field is, the less likely anyone from a non-cognate field will recognise it in favour of their own more personal categories of fields and disciplines. Importantly, the study refutes that 'nearness' of subject-matter is the key factor in this, which is presumed in much of the RoI literature (Newell 1994). Rather it appears to be that the 'nearness' of the *level of categorisation* to the privileged or optimal categorical level matters most. *This means that the 'traditional' and well travelled disciplines would be easy to categorise new subjects into for any academic (humanities, social science, STEM), but newer and more nuanced hybrid or interdiscipline groupings would be less likely to be used over personal 'folk-taxonomies' of disciplinarity and interdisciplinarity except by those within these new groups.*

Rottman *et al.* (2012) also found that certain categories consistently exhibited high-consensus without feedback. These studies, as well as several others cited by Medin *et al.*,

[98] *Genus* is the most recognised level of scientific categorisation of trees (and indeed most things which have scientific taxonomies). It contains many of the 'common' names for trees such as Elm, Birch, and Oak. Many trees also have alternate common names which are not parts of the *genus* category (Medin *et al.* 1997, 51).

suggest that there may be something psychologically consistent with optimal categorisation that is very much like Miller's Law: there may be a human constant of categorical size/complexity. More research would be needed to find out what this may be. Following from the principle of chunking and similar research on TMS, however, if such an optimal size does exist it is also reasonable that as the academic community or wider society becomes itself more complex, this optimal size/complexity may also increase. *Academia as a community could be getting more expert at categorising disciplinarity.*

Creating/Placing New Academic Categories - The Lure of Pluralism

Pothos, Chater and Hines (2011) demonstrated compellingly that unsupervised categorisation of novel items or concepts is increasingly easy as groupings become more high-consensus, obvious, or optimal. This is a widely accepted finding, but they *also* found that this was easier to do when participants are free to create greater numbers of categories (at least up to five in the study, it is reasonable to suspect that Miller's Law may come into play here). Conversely, the study showed that once the new categories were made, *supervised* categorisation of the same items or concepts by other participants (not those who created the categories) was significantly harder the more categories there were. The researchers found that if the difficulty of learning more than two supervised categories was factored out, the predictions based on the simplicity model were nearly identical for supervised and unsupervised, suggesting that it was the act of *learning* new existing categories that accounted for the difference.

Additionally, it is a widely confirmed finding in categorisation research that humans can distinguish things which differ substantially or obviously much faster than ones which are more similar (Sagi *et al.* 2012). When differences are pronounced not only is categorisation quicker, but also consensus is easier to reach without the need for debate, or much of it (Sagi *et al.* 2012; Bahrami *et al.* 2012). The more similar things become, however, the more nuanced and open to debate the distinguishing features become. We can no longer safely presume easy consensus about how to categorise, and we then need to justify our categories to others, who are increasingly less likely to agree.

This process reverses, however, when participants are asked to explain w*hy* they have made the categories they have. We are much more able to explain differences of fine nuance between similar things than between substantially different things (Sagi *et al.* 2012). This study showed that the reason appears to be related to the need to overlay and compare the images or concepts in order to isolate the difference, which is clearly easier

for more similar items. The quicker identification of dissimilar things actually occurs because this overlapping step is bypassed. As soon as we can determine that two things do not easily map to each other, we can forgo further more complicated comparison.

This finding has considerable impact on understanding interdisciplinarity as a means of developing new fields and disciplines, such as hybrids, interdisciplines, IDS programmes, or even pluralistic models of interdisciplinarity as holistic new categories themselves.[99] As these new categories each represent a more nuanced level of classification over and above established disciplinarity, the justification becomes easier to articulate for the individual or group who creates it. But it also becomes more necessary due to the lower likelihood of consensus the more dissimilar or distal from existing categories the new ones are. In terms of expertise this suggests that a number of new interdisciplinary fields (particularly highly technical or specialised ones) may only be identifiable or justifiable to quite high-level experts who can recognise the distinctions, and may not be sensible to others. Drawing again on the 'tree study', the more nuanced and distal these categories become from the base category the less 'optimal' they become; they become the folk-taxonomies of those who make them, which will then not be sensible to others who have their own unrelated folk-taxonomies.

This is perhaps the simplest and most compelling argument against pluralism in interdisciplinarity. *While it is relatively easy and may seem, therefore, productive to create more and more categories and interrelated structures of interdisciplinarity, these will become increasingly difficult for others to learn and use effectively.* When there are also many conflicting models with no clear empirical means to determine the relative value of each the justification for pluralistic interdisciplinarity becomes increasingly untenable.[100]

As such some new fields, such as Women's Studies or Medieval Studies, may not seem justified to academics who are not engaged with the study itself, even when their own field allegedly forms part of the new field, because only those with trained expertise in the new field may have the level of expertise to understand either the justification of the differences or the utility of the new field. This appeared several times in my interviews with medievalists when they were asked whether Medieval Studies should be considered a new

[99] Each of these create new categories of some kind.
[100] It should be noted, however, that if a well evidenced and high-consensus pluralistic model of interdisciplinarity were able to emerge from the pack the story might be different. Pluralism is not inherently problematic as a concept, but it is in convoluted and contested cases such as the current state of RoI.

discipline. Several were confused over why it would need to be, because students could already take joint-honours options if they wanted to.

Pure and Applied Categories

In the second experiment of the 'tree study', taxonomists had an expectedly very high rate of categorising the new trees by the scientific taxonomy. Interestingly though, the landscapers matched more of the new items to scientific categories at the *genus* level as well. The landscapers abandoned their previous goal-oriented folk-taxonomies and instead placed the new properties of different trees into the scientific taxonomy. Although the goal-oriented categories were effective for the landscapers in their working operations, either they were not seen as the most effective for categorising new data or there was another reason that the scientific system was used. Medin *et al.* suggest that the new properties did not match any utilitarian traits of the trees that the landscapers would normally form their categories from, so they defaulted to the most appropriate other model which was the common optimal *genus* category. Whatever the reason, it is clear that multiple categorisation models were operating simultaneously, and without apparent hindrance to each other. *This suggests that the transient, goal-oriented collaborations that make up much interdisciplinary work can effectively have their own thematic or application based categorisation of their place within the disciplines without any need to supersede or contradict disciplinary structures.*

In terms of interdisciplinarity, the differences between tree experts is much like the debate in the RoI and disciplinarity literature over applied and pure fields: between real-world concerns and academic ones. Recall that this argument is typically proposed from a pro-interdisciplinarity 'real-world-problems' perspective, which is normatively dismissive towards disciplinary 'pure' fields. By exclusion this suggests that these are not 'real' or 'of the world', the clear implication being that the traditional disciplines are less useful or desirable. In the 'tree study', taxonomists' categories tended to 'reflect' nature (in as much as we support a realist view of trees), while landscapers' categories tended to impose task related features onto nature. This could be misleading though (much as the pure/applied distinction itself may be misleading), because the task of a taxonomist *is* to 'reflect' nature.

Medin *et al.*'s study demonstrates that normative posturing may not be necessary to resolve the effective differences between different applications of disciplinarity. There is expertise in each, but the purposes are distinct. Medin *et al.* in fact, caution against over-emphasis of goal-oriented categorisation as, "goals do not necessarily partition the full set of entities in

a domain" (Medin *et al.* 1997: 54). That is, there may be a more all-encompassing category or categorical structure which admits each goal-oriented model within it. *A model of interdisciplinarity which allows for multiple goal-oriented valid approaches to disciplinary categorisation within a single coherent understanding of both disciplinarity and interdisciplinarity would be ideal.*

A Little Knowledge?

Something else interesting occurred in the 'tree study' though, unlike landscapers, maintenance workers did not prefer the scientific taxonomy for new categories over their own folk-taxonomies. Maintenance workers more often chose their own folk-taxonomy for categorising new tree properties, even though their folk-taxonomies were closer to the scientific ones than the landscapers, which would seem to suggest that they should be more able to use the scientific taxonomy than the landscapers. Something which is not discussed by Medin *et al.*, but expertise research suggests, is that the maintenance workers may have been overconfident or biased by personal experience in their expertise at categorising. They may have had the confidence of the partially-expert, or have been operating with personal epistemologies of the positivistic type (in terms of the scientific taxonomy), believing with some certainty that their own folk-taxonomies were actually the scientific ones, or that theirs were based on equally rigorous criteria. The landscapers, however, may have been sufficiently novice at scientific categorisation of trees to be aware of the folk nature of their usual categories. This is notably an extrapolation from limited data on the maintenance workers' reasoning, and would need to be researched further. For example they may have preferred their own folk-taxonomies simply because they were aware that the scientific taxonomy was not as well suited to their work. But if there is truth to the partial-expertise notion, then it would provide very strong evidence against the competency models of interdisciplinarity, where the goal is to allegedly be able to effectively use the output of a fully-formed discipline, but with only minimal expertise in it (Thompson-Klein 2005; Repko 2008).

Summary

Although we must categorise, being aware of this fact does not tell us how much or to what extent. In this chapter we have considered the state of research on the psychology of categorisation. The study of categorisation builds on a hierarchical network of principleles which extend from the most basic essential functions of human awareness: that we can discern that one thing is not another thing, through selective attention, unsupervised or

automatic ‘natural’ categorisation, to supervised or deliberate and practiced categorisation. The models for how we go about these build in complexity as well, each nested hierarchically or developmentally within each other. Initially there is basic simplicity and typicality, where we group things which are more alike. Next come exemplar, prototyping and causal categorising in order of complexity, speed and nuanced effectiveness. There may be a parallel between causal categorisation and deep structure matching in expert knowledge transfer, based on the use of causal connections between the deep structures to recognise categorical similarity and make the transfer. This further suggests that there may be an alternate path to a more expert and effective curriculum of interdisciplinarity than competency.

Categorisation relates to interdisciplinarity in several other ways as well though. There is substantial evidence in the research to suggest that there are clear ‘natural’ or optimal categories, which I propose may be related to a basic human range of selective attention capacity not unlike Miller’s Law for chunking. In terms of interdisciplinarity it seems clear that the discipline is this optimal category. A number of studies revealed that creating many new categories is far easier for the creator than it is for others to learn. Further, the domain specificity of expertise suggests that nuanced categories created by experts, such as new hybrid or interdisciplines, will not be sensible to non-experts, and will thereby be ignored or unused. This suggests that pluralism is simply an ineffective approach to developing interdisciplinarity. By adding more levels of complexity, created by experts in interdisciplinary theory, these will be unintelligible and unhelpful to others. Added to this is the unregulated plethora of such models, with little to tell them apart. These imply that pluralism may be the least effective means to promote and develop effective interdisciplinarity in any broader sense.

Similar problems occur when considering the categorisation of collaborative and solitary interdisciplinarity as the same category, especially considering the strong distinctions made in the previous chapter regarding TMSs.

Categorisation research in general suggests that seeking a singular definition of interdisciplinarity, one that specifically places itself well in relation to the most optimal academic category which is disciplinarity, should be the most effective route to building a curriculum model likely to be understood by the most people. Considering as well the proposed basic unity of academic practice in the scientific method, there should not be

substantial epistemological barriers to a single concept of interdisciplinarity, as have been suggested in the past to support some pluralistic models.

Chapter 7: Medieval Studies in Practice

Method of Analysis

The best way to integrate the interview data into this thesis was a troublesome issue. Originally the intention was to conclude each chapter with an evaluation of the interview questions that related to that topic. It was this mapping of the themes to the questions which provided much of the overall structure of the initial research design. However in practice this method not only split the coverage of the interviews across the thesis so that there was little continuity in discussing medieval issues, but it also interrupted the continuity of the narrative across the chapter themes themselves. A similar structure was employed with some success in Lisa Lattuca's 2001 *Creating Interdisciplinarity: Interdisciplinary Research and Teaching among College and University Faculty*, but there were two key differences. First, Lattuca was not focusing on addressing the nature of curriculum and disciplinarity in a specific field, as I am. Second, Lattuca considered the interview data to be of equivalent or even greater value for determining the nature of interdisciplinarity, whereas I consider it only marginally useful for this in any direct sense.

Taking Social Practice Theory as inspiration, the analysis below attempts to balance between the narrative and deep subjective meaning found in discourse analysis, and the aggregate synthesis devoid of subjective meaning found in quantitative analysis. The focus is on the decentred comparative nature of the practices and views described, but with the understanding that making sense of these also these requires attention to the nuance and meaning of each narrative to make coherent comparisons. Neither narrative nor quantitative analysis alone is sufficient. This should not be viewed as a 'mixed method' approach, which would include both quantitative and qualitative analysis separately, but then synthesised. This approach is intended to intrinsically display both some quantitative and some qualitative data in a single analytic pass. To help realise this goal, I have relied on visualisation of the results as the main method of analysis.

Specifically, a mind-map visualisation approach has been taken to present the results. This appeared to be the best way to analyse and display comparisons among the interview responses and the patterns that emerge from these. Although visualisation of interview data is not entirely new, it is uncommon, and this is a new approach to qualitative analysis in this area of study. I believe it can reveal a great deal of patterns and trends which are invisible or occluded in more traditional narrative or statistical approaches. The benefits of

this approach are that the full spectrum of responses can be viewed together, grouped into major trends and with cross correlations where these were notable. The maps have been structured to allow reading of them to be clear and consistent.

Each map extends from the interview question. The first branch of nodes in each map is the collated patterns of results as I have coded them. This layer only represents actual responses if there are no additional branches attached. In most cases, however, this branch represents my interpretation of the actual responses into themes.

The next branch in each map, extending from the collated themes, is the actual responses of the interviewees. These have been set as short quotes, paraphrases or single-word responses, rather than long quotes; the reasons for this are both abductive and practical. Abductively the patterns of the responses are clearer when individual quotations are normalised slightly to highlight the theme of the statements. Practically, long quotes would not fit onto the mind-maps effectively, and would present problems for the ethical requirements of anonymity of the participants in many cases.

The final branch of the maps, which has far fewer entries, represents additional points that participants made about their primary responses. In each case these additional points are attached to the response they relate to. In some cases there have also been significant connection between responses across themes, and the mind-mapping software used for the analysis makes demonstrating these connections possible. It would be possible to draw links between nearly all responses to some extent across themes, such connections have been reserved for those which appeared most relevant only.

Due to the page real estate that the words interdisciplinary and disciplinary require, these have been replaced in the maps with the symbols X for interdisciplinary and D for disciplinary. The exact form of each word should be clear in context, but has been indicated as well by adding characters after the symbols (e.g. Xty is interdisciplinarity, Ds is disciplines).

It will be clear that there are significantly more than seventeen responses in each map, the total number of interview participants. In most cases participants gave multiple responses to the questions. It was important for the comparative analysis of the results to look at all of the statements made, especially as some participants made almost contradictory responses across the discussion of the same question.

The maps themselves represent the bulk of the analysis of the interview results. Narrative analysis was kept to a minimum of highlighting patterns that emerged, as it is the maps themselves which are intended to demonstrate these. Some nuances such as tone, hesitation, and comparative relationships between different questions were not able to be captured in the maps; these have been addressed in the discussions which follow each map.

Also, there were a few questions which did not lend themselves as well to the visualisation approach, either because they were too complex for a single map to be readable on the page, or because a different method of analysis seemed more appropriate. These will be identified in the analysis itself below, and are addressed more narratively.

Interdisciplinarity

How would you define interdisciplinarity?

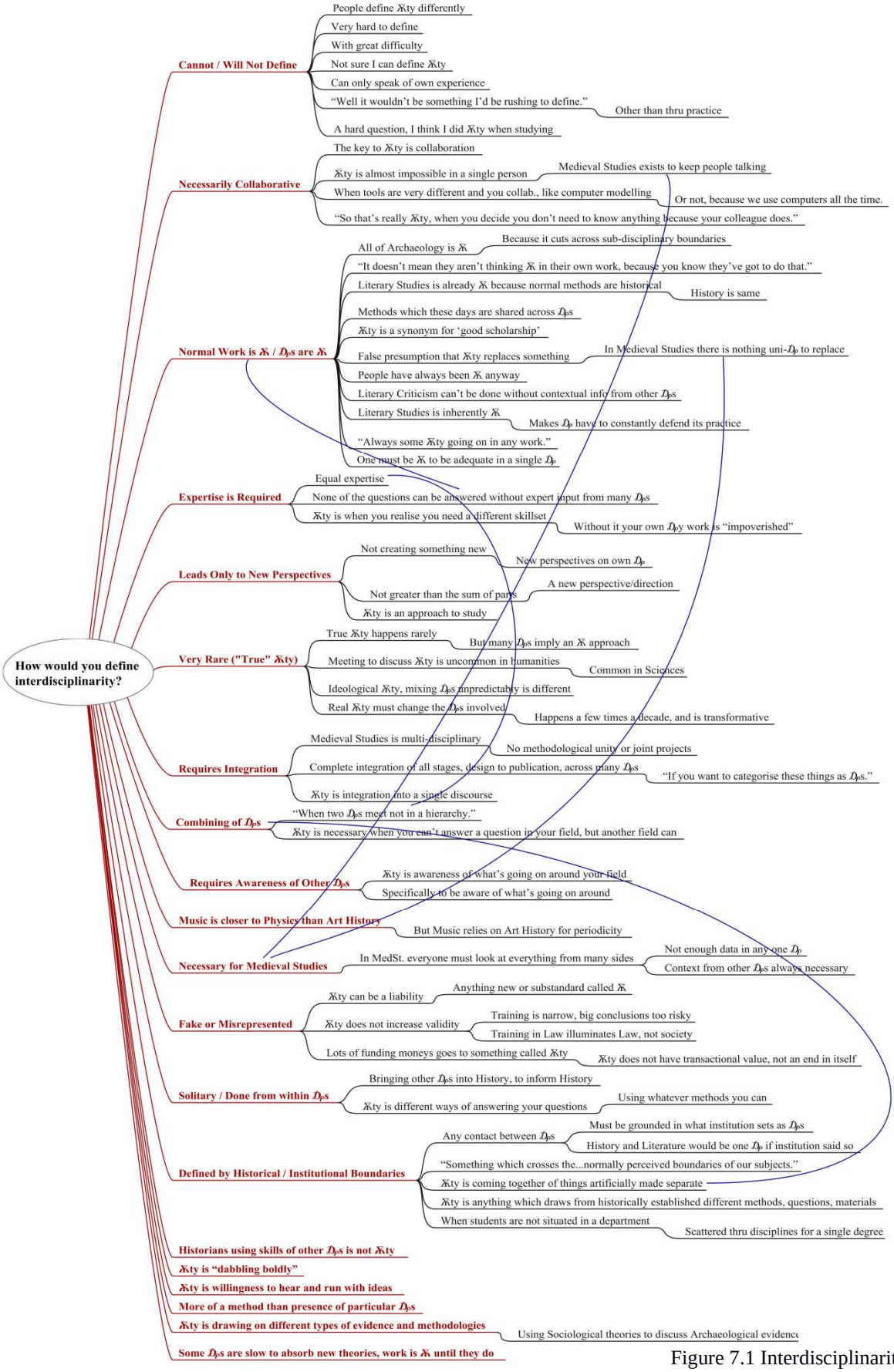

Figure 7.1 Interdisciplinarity

[N = 16]

There are several important patterns that emerge here. The first is the very broad and often contradictory approaches to interdisciplinarity even among a reasonably localised group of scholars working in the same field, many of whom know of each other or have even worked together. Aside from the multi-tiered question on epistemology, this question generated by far the most wide ranging and complexly layered results. Unlike pluralistic models of interdisciplinarity, it is not at all clear that there was any functional pattern of situational or methodological differences between the different concepts, merely that there was no consensus or common understanding.

It was also clear, however, that there were strong patterns in the answers at a deeper level than the surface of the definitions. These patterns focused on the essential elements of interdisciplinary actions and practice. The most obvious pattern was the notion that interdisciplinarity was simply normal practice, or that it was a necessary function of doing one's work (these two notions not being quite equal). There was a significant counter-trend, however, suggesting that interdisciplinarity is rare, is often 'bogus', or is overstated. This again suggests a lack of consensus. Another substantial trend was that interdisciplinarity must be collaborative or that it must involve expertise in more than one field (again, these are related but not the same). This trend also had some opposition, but not as much. Lastly, a surprising number of participants initially indicated that they did not feel interdisciplinarity could be defined, that they could define it, or that it should be defined.

What is also clear is that there was only one response which suggested anything like a competency approach ("dabbling boldly"). There was also a trend of tacit disciplinary essentialism present in most answers, in the form that only a few participants clearly attempted to consider the question from outside the focus of their own field and what other disciplines could bring to it.

Do you see interdisciplinarity as individual or collaborative, either or both?

Figure 7.2 Collaboration

[N = 16]

There were a few clear trends in answers to this question. In one capacity or another, the majority of answers favoured collaboration as either the only way to do interdisciplinarity, or the preferred way. There was, nonetheless a substantial amount of responses in favour of individual interdisciplinarity, at least on the surface of the answers. This is consistent with the background of the humanities more generally, where collaborative projects are not the norm yet, though this appears to be changing.

Answers in favour of individual interdisciplinarity were consistent in specifying that this required considerably more time to achieve, because substantial expertise would be needed in each subject. In several of the answers it was stated or implied that this meant that individual interdisciplinarity was rare in practice, or as one participant called it 'bogus'. These answers are consistent with other accounts of interdisciplinarity in Medieval Studies. In a published 2006 conference on interdisciplinarity between chiefly Archaeology and History two separate presenters focused substantially on the problems with insufficient expertise or excessive time commitments for solitary interdisciplinarity (more below).

Another theme that was consistent with whether participants favoured collaborative or individual approaches was that expertise in one's own discipline was essential to any attempt. Further, awareness of the state of other disciplines was necessary. Each of these is consistent with the answers given later for 'what makes a good interdisciplinary researcher?', showing a stable pattern across the questions.

Epistemology

Can you discuss what you think of the terms 'truth', 'validity' or 'evidence' in Medieval Studies?

[N = 16]

Because this question was effectively three separate but interrelated questions, a visual map of the responses would be far too large and interconnected for the space available. There were very strong patterns in the responses though, as well as a few notable outliers.

The single largest trend was that no participant suggested that there was such a thing as objective 'truth', all were very clear about this. Most expanded this to suggest that there were definitely better or worse answers and definitely some that were simply wrong. Two participants did, however, suggest a more relativistic approach of equally valid multiple truths. It is important to note that each of these identified as literary scholars of some kind, and it was either explicit or implied that this relativism referred chiefly to truths of literary meaning.

Approaches to evidence were also very consistent across all interviews. Responses such as "evidence is everything" or "yes, as much of it as you can get" were common. Many also noted the very wide range of types of evidence, and suggested that the need for expert skill at evaluating these was why interdisciplinary collaboration was important. All participants suggested either directly or indirectly that evidence is not 'pure', in that it is always affected by our own choices, prior knowledge, and interpretations.

There was also wide agreement on defining validity, though a few participants expressed confusion at how this term was to be taken, such as whether it was meant to imply objective truth? Validity was seen as the essential link between evidence and the impossibility of truth. The majority (13) focused on validity as the building of a strong coherent argument from the evidence. Validity was also equated directly to 'rigour' by

several participants, as well as to being what most defines academic activity. Peer-review and making ‘good’ arguments were also commonly mentioned. The coherence of the responses is compelling support for the place of the scientific method as a core academic method, even in the humanities.

An interesting change occurred though in answers to the follow-up question “Do you perceive that there is general agreement on these terms among medievalists...?” Regardless of the strong agreement across the disciplines which was demonstrated in the first question (which is also consistent with the wider literature), about half of the respondents indicated that there was only limited pragmatic or functional agreement across the disciplines on the approach to truth, evidence and validity, and that there was with substantial debate and disagreement beneath this. Specifically this was regarded as a generational issue more even than a disciplinary one, though some participants did specify discipline based differences. A few also suggested that disagreement on this matter was good, even essential to academic debate and progress.

Disciplinarity

How would you define a discipline?

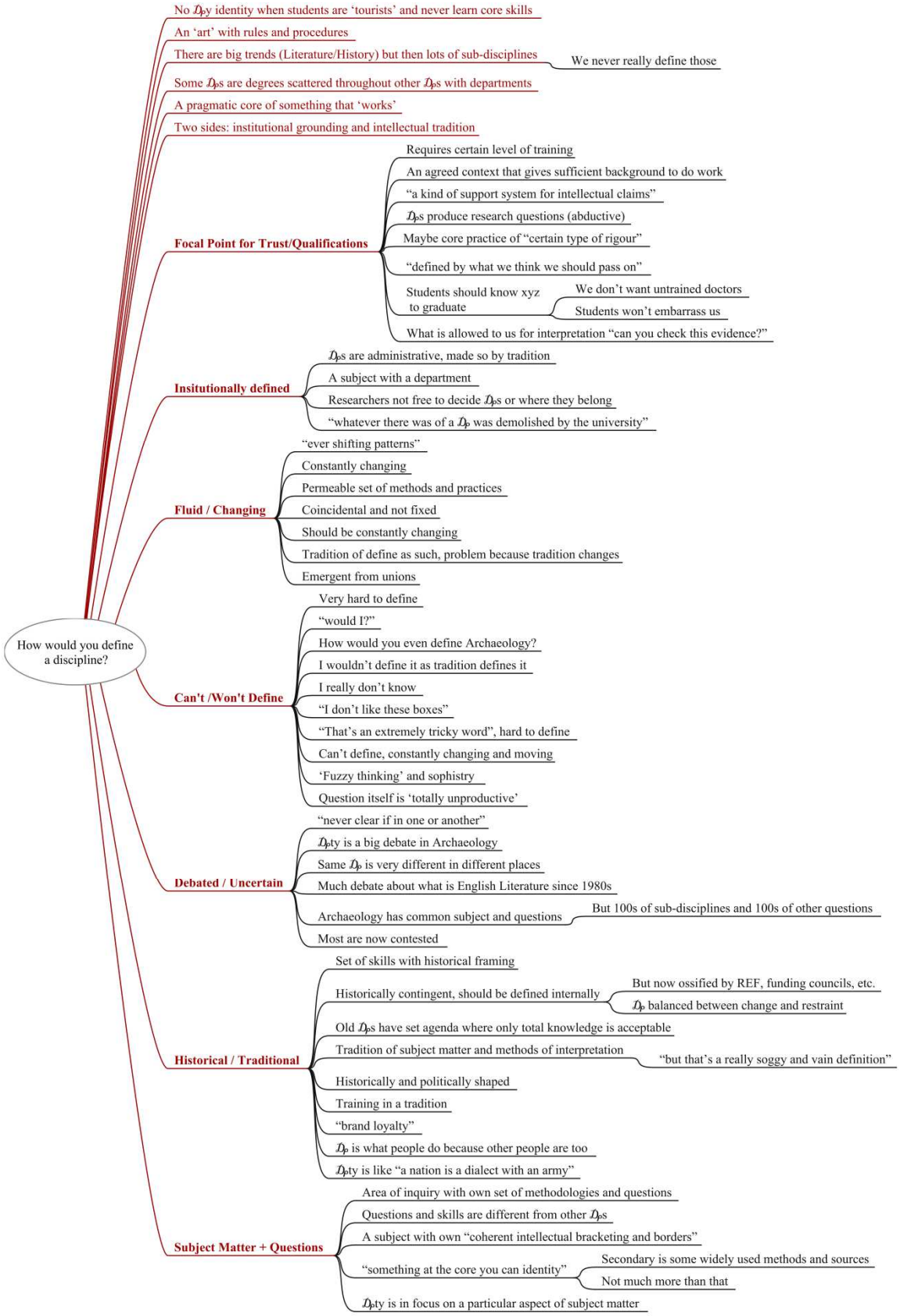

Figure 7.3 Disciplinarity

[N = 16]

Responses here fell into several quite clear themes, none of which were unexpected, except for the again quite high number of participants who initially declined or felt they could not or should not try to define a discipline. This was seen as well in the responses to defining interdisciplinarity. What the maps do not show, however, is that it was in most cases participants who were willing to define one who were then hesitant or unwilling to define the other.

Strong themes of social construction (even in the form of institutional construction) dominated the responses. Only a few responses suggested anything approaching a subject-matter based objective definition of a discipline. The nature of these responses is not surprising for a humanities field. The same question asked of academics in an 'interdisciplinary' STEM field would be interesting to compare with these. Most interviews on interdisciplinarity and RoIR studies have not asked this question though.

Expertise

What, in your view, makes a good interdisciplinary researcher?

Figure 7.4 Expertise

[N = 15]

What is most notable here is that the responses were highly uniform and that they conform quite closely to the skills desired of interdisciplinary researchers and team members in STEM disciplines from the RoIR literature:

- Curiosity about, and willingness to learn from other disciplines
- Flexibility and adaptability
- An open mind to ideas coming from other disciplines and experiences
- Creativity
- Good communication and listening skills
- Ability to absorb information and its implications rapidly
- A good team worker (Bruce *et al.* 2004: 464).

This suggests there may not be much difference between the 'two cultures' when it comes to interdisciplinarity and how to facilitate it. It further suggests that there may be room for a generic structure of interdisciplinary curricula, likely embedded in disciplinary or field contexts, which could be applied across the domains from arts and humanities to STEM, and even the creative arts.

Also present was a strong, usually explicit, undercurrent of collaborative necessity either in the form of communication skills or understanding one's own limits and seeking external expertise, though the latter could include an individual reading external sources rather than direct collaboration.[101] This was true even of several participants who had previously said that interdisciplinarity was or could be a solitary endeavour.

Notably, it was the same participants that identified interdisciplinarity as rare or difficult who also suggested that the necessary skills for interdisciplinary work were hard to come by.

[101] There was an undercurrent in some interviews which suggested that consulting the published work of other fields, especially monographs, was a form of collaboration: this is a debatable perspective but one which is slightly beyond the scope of this project.

Do you think this [Being a Good Interdisciplinary Researcher] can be learned or taught?

Figure 7.5 Teaching Interdisciplinarity

[N = 14]

No participant suggested that being a good interdisciplinary researcher could not be taught. Most participants suggested that any student could be taught to be interdisciplinary, though several did suggest instead that it was a proclivity, talent or intrinsic interest in the student which needed to be developed if it was present. One likened it to ‘leading a horse to water’. It was clear, however, from the tones of the responses that most participants were reasonably optimistic that a curriculum of interdisciplinary development *could* be implemented in theory. It was also clear, however, that there was a strong perception that the current curricular or administrative structures were a hindrance to this, or that there were key elements which might be difficult to achieve.

The order in which learning needed to take place was mentioned by several participants, most suggesting interdisciplinarity needed to be taught early. This suggests a tacit (or explicit) awareness of the problems of cognitive entrenchment, though when this is coupled with the strong need for disciplinary expertise that most participants also considered essential to interdisciplinarity, the previously mentioned ‘paradox of interdisciplinary curricula’ is clear in practice as well as theory. This suggests a more delicate balance needs to be struck.

Are there particular skills or knowledge which you feel every medievalist should know?

Figure 7.6 Medieval Skills

[N = 16]

The results here appear to fall very well into a few simple categories, which would indicate a possible core skill/knowledge base for Medieval Studies, something that might imply burgeoning disciplinary identity. But the details are a bit more questionable. The 'languages' core skill for example was mentioned in some way by nearly all participants, with Latin being a clear leader as a necessary skill. However, there were almost as many responses suggesting that Latin was *not* a required skill for a medievalist, especially if one was focused on visual and material culture in some way.

On the one hand this suggests an implicit disciplinary essentialism in presuming a textual hegemony over the study of the period, and on the other it suggests essentialism in reverse by presuming that students could be studying only archaeology or art history and would not need languages. One would expect a fully integrated Medieval Studies not to include either situation.

There do, however, appear to be several core skills that might suggest a base for a disciplinary approach to Medieval Studies: a generalised understanding of historiography and source criticism (being the skills of interpreting historical sources of any kind), a knowledge base of the culture of the period (particularly church culture was mentioned), languages of some kind, and an awareness of what the various specialisations of the field entail (archaeology, history, literature, art history, religious studies, etc.).

Categorisation

How would you define or differentiate the 'medieval' period?

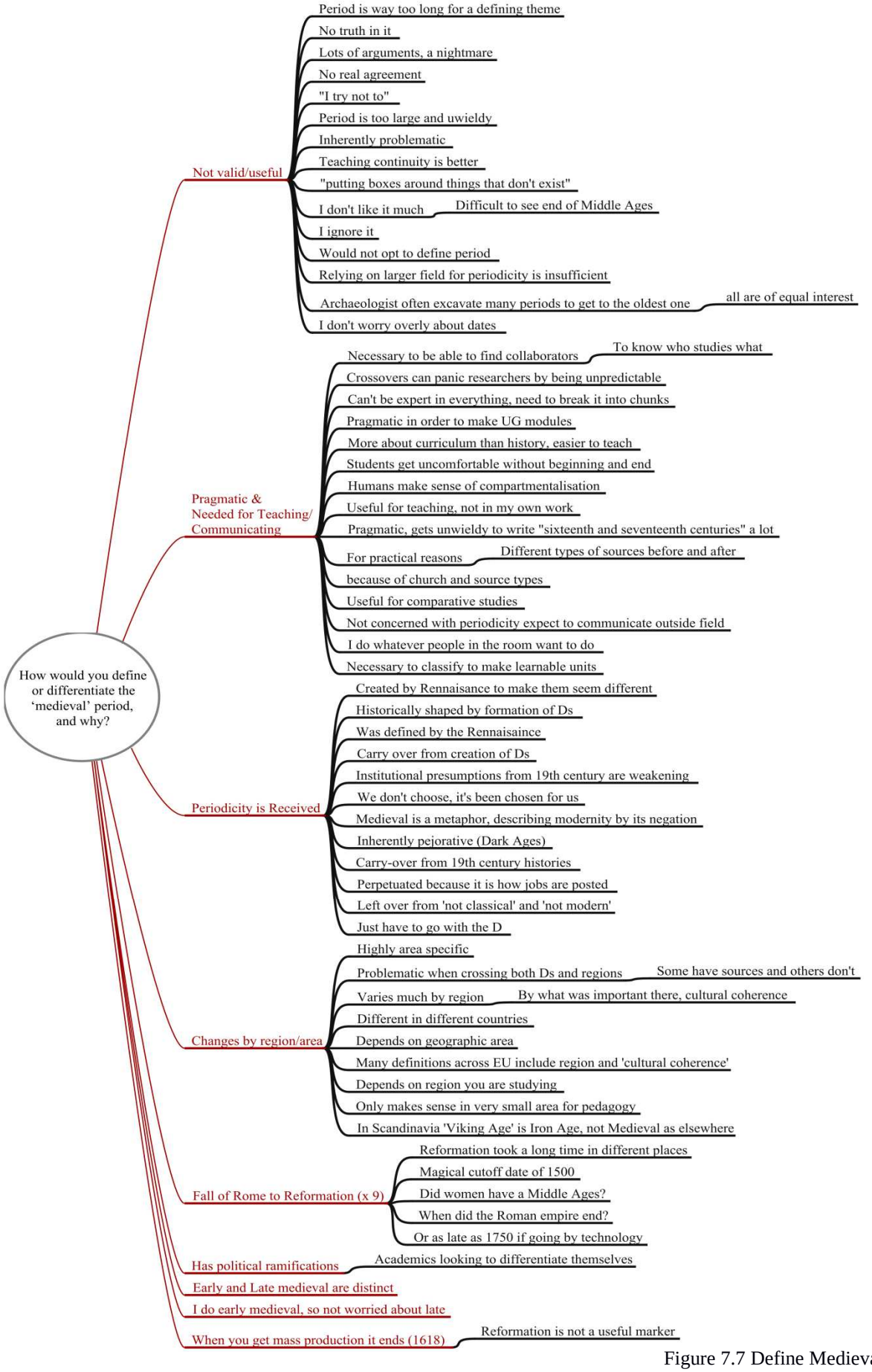

Figure 7.7 Define Medieval

[N = 17]

The only question which actually asked participants to actively categorise, to a limited extent, was how they would define or differentiate the medieval period. This question produced a wide range of results, but in fairly uniform groupings. Some had a quick and easy start and end point in mind, others felt there was no suitable way to demarcate the period, and a third substantial group felt it was context dependant (either by discipline or by geographic region of study in most cases). There was some indication of discipline specific leanings, but the sample size is too small in each to reliably draw conclusions.

What is only somewhat clear in the map is that even though more than half of the participants gave the fall of Rome to the Reformation as a date range for the period, there was a strong general resistance to the reality of a period-based categorisation as anything but pragmatic at a surface level. Most described at some length how or why the period has been traditionally demarcated, is merely professionally or pedagogically expedient, or should not be demarcated at all. *No* participant offered dates for the period without substantial caveats. That the identification of the same general period was contingent on specifically which culture or geographic region was the focus of study was frequently stated. This is consistent with Chazelle and Lifshtiz's assessment as well. There was also clear acknowledgement that periodisation was contingent on which discipline was asked, as the features of the period which were important to each appeared and disappeared at different times in different places. A considerable amount of the responses could be viewed as describing a range of measures of selective attention suggesting that the Middle Ages is too broad for maintaining attentional focus on as a single unit.

Many participants were clear that the periodisation of the Middle Ages was a received value that merely had to be worked with pragmatically in order to be understood outside of the expert circles of their own research. There was some sense in a few interviews that the discipline of History held some hegemony over the others in terms of periodisation, but more responses placed the source of the periodisation on the establishment of the disciplines in the 19th century, or on the scholars of the renaissance who sought to create an 'us versus them' self-identity as better than the 'dark ages' and more like the enlightened classical period before it.[102]

[102] The similarity of this notion to the arguments for interdisciplinary 'betterness' have not gone unnoticed.

Nature of Medieval Studies

This table shows the answers given to two different questions about how to perceive Medieval Studies side by side: 'Is Medieval Studies interdisciplinary' [N=9] and 'Could or should Medieval Studies be considered a discipline in its own right' [N=16].

Is Medieval Studies Interdisciplinary?	**Could or Should Medieval Studies be Considered a Discipline?**
Hard question. Maybe not interdisciplinary enough? College system limits interdisciplinarity and collaboration	Yes, it could. Seems best at postgraduate level
"If you put two medievalists in a room they will have formed an institute in about 30 seconds." Yes, because it pushes against institutional structure	No. No matter what anyone says, primary academic disposition is formed by the home discipline. Medieval Studies can't be a home discipline itself, the subject is too big and is negatively defined
Contingent on context. Very different from institution to institution, from UK to US, early medieval to late - and that's okay. Early medieval has to be interdisciplinary, late not so much.	It can be, in some places it should, some it shouldn't. Good to have horizontal and vertical colleagues both. Ideal if both systems running in same place.
It is certainly interdisciplinary, it has people with different expertise's working together	Hard question. It could become a discipline, but would it lose its connection to the disciplines?
By definition it is interdisciplinary, it is a concept lifted out by people realising one discipline can't look at Middle Ages	Not a problem, it already is. Don't need to justify it. It's an interdisciplinary discipline
Depends on individual perspective and training, difficult to label	Don't know, no view on it.
It is inherently interdisciplinary, always was where I learned it	No, not necessary. Works as is with people in own subjects, better chance of encountering new ideas. Might get isolated if made a discipline
Yes, that makes sense. I would be able to know what fits.	Would be hard for UG, but could work in America. Intellectually not a problem, structurally and organisationally difficult. York tried but let it go. Needs to create its own environment. Early and late medieval need to be separate
Yes, it really has to be to do it well	Not sure, it's an artificial boundary already which is already covered by many disciplines and connects to before and after. Regional sympathies seem to override periodicity
	No "I suppose the comparison would be things like Regional Studies or National Studies, Cultural Studies...Cultural Studies is still so problematic. Area studies isn't a discipline is it?"
	"Not thinking much but no."
	No "if you were going to train up a medievalist from the age of 18 as an undergraduate they would have to be doing courses in five or six different subjects". It would be great if the right options did exist.
	Maybe, because disciplines are fuzzy anyway. But then it includes other fuzzy disciplines, maybe and 'interdiscipline'?
	Yes, certainly, only reason it isn't is tradition
	Yes and no. Only problem is not having time to learn, it would be superficial. Could do a base and then specialise. 1st and 2nd year general Medieval Studies core concepts/methods
	It should be…but how? Split early and late medieval makes sense. But how to sustain something like 'generic research methods for humanities'?

Figure 7.8 Medieval Disciplinarity

The first question was asked very early in the interviews. The second question was asked at the very end. Not all participants addressed the first question directly, usually because they had already implied an answer while responding to an earlier question. Each row of the table represents the responses from the same participant for comparison.

The clear trends here are that Medieval Studies was consistently seen as interdisciplinary, usually inherently so, without much debate or dissension. The potential disciplinarity of the field, however, met with a much wider range of responses, and the general sense was that it might be possible, but would not be desirable or institutionally feasible. Notably though, a few participants were strongly in favour of the idea.

Medieval Studies Undergraduate

“Hypothetically, if Medieval Studies were to be offered as an undergraduate programme how do you think this would fit with the existing disciplines which commonly make up the field?”

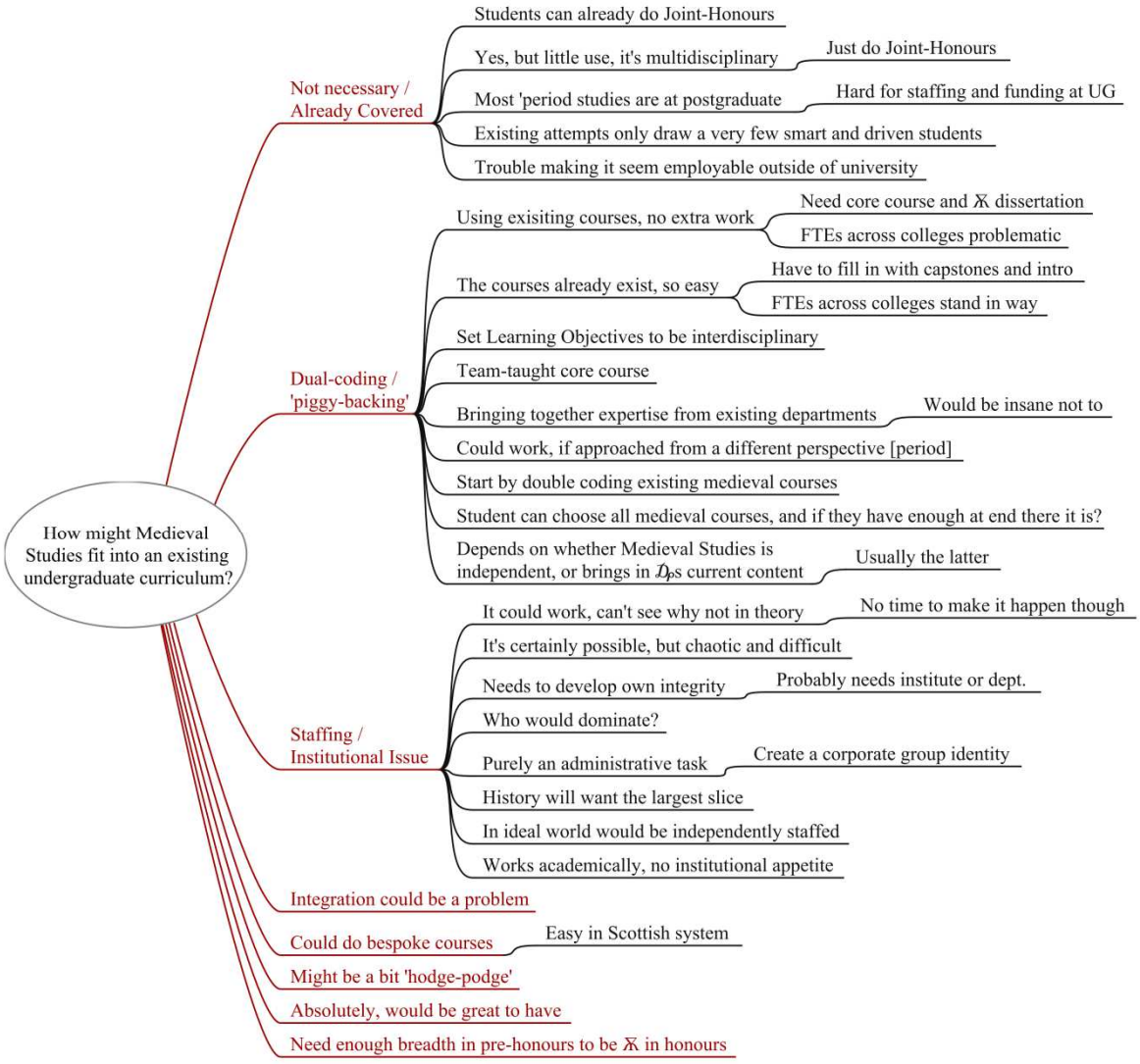

Figure 7.9 Medieval Undergraduate

[N = 14]

Regardless of the positive or negative answers to the previous question about whether Medieval Studies could or should be a discipline, participants were asked at the end of the interviews to imagine how an undergraduate Medieval Studies programme might look if there were one. In most interviews I specified that this could be viewed as a discipline or as an interdisciplinary programme, so as not to collide with the previous question.

Three substantial patterns emerged. Several participants focused on how unlikely this would be for staffing or institutional reasons, though at least one suggested that it was quite possible if it was administratively driven. Alternatively, several responses suggested that developing such a programme would be feasible, perhaps even easy, by dual-coding or

‘piggy-backing’ onto the existing medieval course offering of the cognate disciplines, and adding a capstone and introductory course. Finally a few participants were somewhat incredulous about why there would be any need or desire to do such a thing, because students were already able to take a range of medieval modules if they wish in the first two years in the Scottish higher education system, and further could choose joint-honours if they desired to be interdisciplinary.

Undergraduate teaching experience

“In undergraduate teaching, have you ever taught in an interdisciplinary manner, such as team teaching, switching between different areas of your own expertise, or including evidence or material from another discipline in a course?”

One of the areas of interdisciplinary curricula that this thesis has intentionally not focused on is module by module pedagogy, preferring to look towards a broader notion of pedagogic reform. I did question medievalists about their own experiences with interdisciplinary teaching, however, and some of the insights are worth noting, even if much of the discussion was more particulate than the broader focus. Five participants said they have never engaged in interdisciplinary teaching in their practice. This left [N=12] who indicated some self-identified interdisciplinary teaching experience.

Interdisciplinary teaching was in every case discussed as something that occurred in some modules and not in others, though a few participants implied that this could/should be more common or normal. Most participants referred to team-teaching on large survey courses and specialist honours courses, or guest lecturing in courses in other disciplines. There was no consistent view on how well this worked, how integrated the knowledge was, or whether interdisciplinarity should be made explicit to students or not.

Some preferred to discuss the transfer of ideas across source types with students, but without mentioning disciplines. Others were explicit about all features of interdisciplinarity. Still others felt that this only caused students to believe the task was difficult and therefore likely to fail, while if they weren’t informed they performed well and without fear (‘look, you’ve done it’). None of the participants discussed actual development of the skills that they had mentioned when asked about what makes a good interdisciplinary researcher. It was implied, though not entirely clearly, that these were presumed to be a natural result of interdisciplinary coursework and teaching, much like Newell’s assertion that such skills are a ‘by-product of interdisciplinarity’ (Newell 2010: 363).

Analysis

Some strong patterns emerged from the interviews as a whole. Many of these correspond well to the research in the previous chapters. In many cases this was clear at the surface, though in a few cases the patterns had to be extrapolated at levels beneath the surface statements, such as the definition of interdisciplinarity itself. The integration of the interview data with the rest of the evidence to form conclusions is the focus of the next chapter, however, a few connections and trends are worth mentioning here briefly.

It was clear that defining interdisciplinarity and identifying what is required to do interdisciplinary work are approached very differently. The former question elicited a wide range of responses and reactions, and a substantial amount of resistance to even supplying an answer from several participants. The latter question, however, produced none of the same trepidation or hesitation. Although the answers to the second were in a general sense consistent with the trends found in answers to the first, in the second question these trends were much clearer and more focused. What these suggest together is that describing interdisciplinarity as 'thing' does not make much sense in the realm of actual practice. Not only were answers relatively focused, clear, and consistent when participants were asked about the active practice of interdisciplinarity, but the answers to the being asked to simply define interdisciplinarity fell into similar patterns anyway, though more haphazardly and amidst contradictions and doubt.

A similar comparison can be made between descriptions of disciplinarity and interdisciplinarity. While disciplinarity was consistently defined in terms of boundary conditions of some kind (tradition, administrative value, subject properties, method, etc.), interdisciplinarity was consistently defined as a practice. The manner in which the questions were asked undoubtedly had some effect on this (define *a* discipline, define interdisciplinar*ity*), but the fact that disciplines were almost never defined in terms of practice may be significant.

Another interesting finding here, which is not clear from the map, is that several participants who were quicker and more articulate with definitions of interdisciplinarity then struggled or declined to define disciplinarity. The same was true in reverse, with those who were able to offer definitions of a discipline quickly often being those who declined to define interdisciplinarity. This could imply a number of things, or may even be merely

coincidence, but one possibility which coincides in a general sense with other research is that by defining one, many conventional definitions of the other become difficult to maintain. This is an extension of the essentialism problem. By clearly defining interdisciplinarity, it appears that this may not leave room for a credible definition a discipline, or the reverse. Another possibility is that the concepts of either disciplinarity or interdisciplinarity simply do not make practical sense to some people, at least in terms of their own practice. The alternative which I find most compelling though is that the two are simply not the same type of 'thing' at all, but the names suggests they should be, and this confuses many attempts to define them. This is why I approached asking about interdisciplinarity in several ways.

Another important trend which is not visible in the maps appeared in the question on epistemology. Several of the self-identified literary scholars suggested that knowledge was constructed and uncertain in their own field, but that historians in particular were positivists/objectivists. All of the historians interviewed, however, expressed the same constructed and uncertain nature of knowledge as literary scholars, and further suggested this was the common approach in their field. Recent literature on theory of history suggests the same (Coloma 2011; Korostelina 2008; Kleinberg 2007). This perceptual disconnect corresponds to the narrow domain specificity of high levels of expertise. This suggests misperceptions of other disciplines as being inherently less nuanced than one's own, which may again be tied to the increase in within domain nuance that expertise engenders. Further, this trend may indicate a degree of highly specialised 'folk-taxonomy' such as positivistic history. This categorisation, if consistent, could have an impact on the prospects of interdisciplinary communication.

In 2006 a conference was held in York with the title *Approaching Interdisciplinarity: Archaeology, History and the Study of Early Medieval Britain, c.400-1100*. The articles published from this conference in 2009 address many issues of expertise and disciplinarity quite succinctly in regards to medieval studies. The comments of several of the authors illuminate a clear recognition of the loss of depth that interdisciplinarity creates which is consistent with the interviews above. Of particular concern for several presenters were the problems with attempting solitary interdisciplinarity:

> "However, all too often the use of evidence from other disciplines will consist of using select examples of material culture as illustrative...or visa versa by a historical parallel analysis which does not consider fully the variety or variable reliability of written sources" (Capper 2009: 11).

> "No interdisciplinary study can approach source material with the in-depth approach of a specialist. It is therefore tempting to accept without question the interpretation of specialist reports...However, much more value can be gained from specialist reports by acquiring enough expertise to understand the primary data..." (Holas-Clark 2009: 25).

Holas-Clark additionally noted that doing an interdisciplinary project itself required narrowing the potential scope of the project significantly to make allowance for this extra training (Holas-Clark 2009: 25). This loss of depth can be seen in terms of expertise as an effect of domain specificity.

The most consistent assault on competency interdisciplinarity was that each paper addressed concerns of actual experiences of misuse of their own field by those from other fields claiming interdisciplinarity. For example, Morn Capper cited a statement concerning Clifford Geertz, "...that historians made the cardinal sin of following an anthropologist, not anthropologists, and certainly not anthropology" (Goodman 1997: 784-9 cited in Capper 2009: 11).

Chapter 8: Discussion

Disciplinarity

A definition of interdisciplinarity must rest on knowing how to define a discipline (or so it appears).That the formation, functioning and perpetuation of disciplines are largely social events is not controversial. Regardless of the details, the evidence for this as a basic pragmatic fact is almost incontrovertible; we can trust this like we trust gravity. But is social construction a prime mover, or is it an emergent property of other factors such as the psychology of expertise and categorisation? The approach here has been to view these practices as arising within demonstrable conditions of *possible* practice. Piaget suggested that no discipline exists that does not emerge from a splitting or combining of previous ones, and this could be taken to imply a purely constructivist origin, but we must ask whether there are external stimuli or constraints for such changes which constitute non-social causal factors or limitations (Piaget 1972). Social Practice Theory sees the construction of disciplinary cultures arising from the demonstrable practices of participants. Expanding on this, I have asked whether there may be conditions in which these practices can or cannot arise. The evidence for some of these conditions has been examined in the previous chapters, now it remains only to bring these together and to see how they might help form a complete concept of disciplinarity.

When defining disciplinarity it is important to recall Karl Popper's insistence that theories must not be subjected to excessive *ad hoc* expansions and exceptions, lest they rapidly become non-falsifiable and therefore not theories at all (Popper 1992: 81). The approach to disciplinarity is a theory, and while it is desirable to find the simplest definition which has the greatest explanatory ability, there must always be an eye towards ensuring that the definition remains something which can be validated or shown false, and that it has not become too broad to adequately define. A suitably complex and yet falsifiable definition of disciplinarity should ideally absorb or prohibit many of the existing approaches to interdisciplinarity which have been demonstrated as problematic in the preceding chapters. But because interdisciplinarity does appear to exist in practice *in some way*, there must still be sufficient room left around our definition of disciplinarity to define that as well. In fact this should count as a test of the falsifiability of the definition of disciplinarity: that we can indeed use that definition to differentiate and define something which is related, but is not the same.

Expertise & Expert Language

A number of neo-Foucaultian accounts of disciplinarity have suggested that disciplinary languages are exclusionary, and are chiefly tools of power and control in a negative sense (Messer-Davidow *et al.* 1993; Thompson-Klein 1996, 2010b; Bernstein 2000). One important outcome of the research on expertise though, is that disciplinary language structures should not be seen as *merely* or *primarily* power arrangements meant to keep the uninitiated in the dark. Chunking and expert categorisation have long been associated with semiotics (Lakoff 1987). In order for greater chunking operations to take place, and for faster more accurate memory and recall to happen, more comprehensive terms are required, terms which encompass far more concepts than simpler, more commonly understood terms.

It is not disputed here that elite language can *become* a tool to leverage and sustain power. Rather, the evidence in the previous chapters suggests that this is an opportunistic or reactionary *emergent* property of a necessary aspect of expertise development, rather than being an accidental or intentional result of power dynamics as a prime mover. Unfortunately, this necessary facet of expertise development is also easy to subvert for subjugation, control and exclusionary practices, and this has been the focus of much study on language in disciplinarity in the recent years. The social power issues with expert and disciplinary languages become particularly clear when making expert knowledge explicit or transparent potentially threatens job security or professional prestige (Becher 1989; Hyland and Bondi 2006; McArthur 2010; Huutoniemi 2012). The application of expertise research to this equation suggests that efforts should not be focused on interdisciplinary or even transdisciplinary resistance to the strong presence of the disciplines, but on isolating and removing bad practice and bad internal perceptions of the position of disciplinary expertise and language from within. As McArthur (2010: 308) has noted, disciplinarity is useful, it is only bad practice that we need to contest as non-emancipatory.

The consideration of agency in enculturating disciplinary Ways of Thinking and Practicing (WTP) encompasses the notion of expert languages as part of the process. The work of Adele Nye *et al.* (Nye *et al.* 2011) is a follow up of WTP in History in order to expand the scope and reliability of the data in relation specifically to *agency*. As Nye *et al.* define it, 'historical thinking' means thinking about “historical significance, evidence, continuity and change, historical perspectives” (Seixas 2006: 1-2 cited in Nye *et al.* 2011: 764). But this is not a natural state, it is a learned one, which is why the requirement of agency is important (Anderson and Day 2005: 331). Nye *et al.* define agency as, “conscious and informed

action for which one takes responsibility and accepts ownership" (Bandura 2001: 6-8 cited in Nye *et al.*: 764).[103] Put together these become, 'conscious, informed and responsible ownership of considering historical significance, evidence, continuity and change and historical perspectives'. What is not explored in either study (Nye *et al.* or Anderson and Day), is that replacing the name of any field for 'historical' should not alter the veracity or applicability of the statement, therefore 'disciplinary thinking'.

For example, a historian does not employ the same specific method for analysing the political ramifications of a 12th century Latin charter as they do for considering what a 19th century romantic poem says about the lives of women, but in both cases they would employ these methods in a 'historical' manner, as opposed to a 'literary critical' manner, and further still each employs a wider humanities 'critical theory' approach, and finally the broadly academic principles of the scientific method above this. Just the same, a physicist considering refractions of light through a lens will not use the same specific process as they would to consider radioactive decay of unstable particles, but both actions will be informed by an underlying base of 'physics thinking' which make how they approach these studies different from how a chemist would, followed by a wider scientific approach to experimental design, and finally again the broad academic principles of the scientific method (Voss *et al.* 1983; Schunn and Anderson 1999). At each level a more specialised expert language is required to carry more precise chunks of meaning to fellow experts (Ericsson 2006).

But while a fundamental need for specialised language is clearly a boon to understanding disciplinarity, such that more comprehensive and nuanced knowledge can be transmitted in more efficient and more discriminant chunks, it also presents a clear hindrance to interdisciplinarity because this language is incomprehensible to the non-expert, and further because experts often lack the skills to make their meaning clear (it is tacit knowledge to them) (Chi 2006: 26). Many interdisciplinary researchers have addressed the language issue, often referring to the development of a new meta-language for collaborative work in terms of creoles, pidgins or trade cants (Thompson-Klein, 2004; Nikitina, 2005).[104] Problems with communication across disciplines have also been among the most consistently reported issues on interdisciplinary research teams (Bruce *et al.* 2004; Griffin

[103] The link here to expertise research and *deliberate* practice in order to form more complex chunks of historical understanding is clear.
[104] Ironically these terms have very specific meanings to the expert linguists who coined them, which are not clearly the definitions used in the interdisciplinary literature, possibly demonstrating a need for more disciplinary expertise in the application of them to interdisciplinarity.

et al. 2006), and also on interdisciplinary funding councils (Huutonemi 2012). I propose that not only is the presence of a specialist language to facilitate expert communication a foundational property of disciplinarity, but that by extension *coping with* this is a definitional property of interdisciplinarity.

Subject Matter

That disciplines are somehow defined by subject matter is nothing new. Subject matter has been one of the primary defining factors in nearly every definition of disciplines offered. It was stated as the root of Biglan's classifications, from which Becher built his ethnography as well (Biglan 1973a: 195). These have, however, failed to regard the subject matter in its own right, but instead as something perceived through the disciplines as socially constructive entities themselves. Biglan's model, for example, said nothing about the qualities of the subjects covered by the disciplines, in fact these were not much mentioned. He focused instead on the *relative perceptions* of the disciplines by existing practitioners (Biglan 1973a: 201). Trowler as well, in his resistance to epistemological essentialism in the definition of disciplines, regards this essentialism from the standpoint of the Biglan-Kolb-Becher combined models of social, paradigm, and application based categorisations (Trowler 2012b).

Karl Popper has suggested that it is not actually ‘subject-matter’ that we study though, “We are not students of some subject matter, but students of problems. And problems may cut right across borders of any subject matter or discipline” (Popper cited in Greaves and Grant 2010: 1). There are problems with such a view though, which get to the pedagogic heart of many of the problems around interdisciplinarity. When Popper says *students* it is clear that he means *researchers*. Students on the other hand need to develop expertise in a qualified and reliable subject in order to be useful and effective for researching problems. This process could be forgone, but it would undermine the development of WTP which lead to enhanced critical thinking and skill in a subject area, and to the expertise that allows problem solving to be done faster and more effectively (Anderson and Day 2005; Chi 2006).

When Rowland and others refer to ‘what is considered evidence’ as a defining factor of disciplinarity, they should more accurately be referring to ‘subject matter’ and focus of study (Rowland 2006: 93). Defining a discipline by what evidence is to the practitioners focuses on the nature of evidence itself as pluralistic, which leads to relativistic problems. Defining a discipline by the subject matter (subdivided as needed by focus of inquiry) is

very similar to the 'approach to evidence' concept, but the subtle difference is a critical one, much like the subtle essentialism inherent in the borrowing metaphor of interdisciplinarity. 'What is evidence' is dependent on the focus of questions the discipline asks. But subject matter is relatively fixed and forms the primary identity core of the discipline, the focus is socially determined and is the *secondary* identity aspect of the discipline; the identity which separates it from other fields looking at the same subject matter. Rowland views the difference in 'evidence' between Health Studies and History as a matter of incommensurability, but I prefer to look to the superordinate matrix of categorical similarity which makes these both translatable into the same core methodologies of academic knowledge: the scientific method (Rowland 2006: 93-95).

The meaning of 'evidence' in the disciplines then is not *first* socially constructed, but is a relatively stable understanding of the inherent qualities of the subject matter which generate the conditions which arise as a socially constructed consensus using whatever means are deemed most appropriate to do this. The evidence forms a 'relatively privileged' or optimal categorisation. Certain objects of disciplinary focus are only capable of providing certain types of answers. For example, no matter how much we may try, we will never be able to make a rhododendron yield secrets about the power of the Carolingian dynasty, and conversely a Carolingian court document is not actually capable of telling us about plant photosynthesis.[105] By this interpretation, the intrinsic epistemological qualities of the subject matter lead to particular ways of thinking and practicing about the evidence, its value and context, the methods needed to derive knowledge from it, how it can reasonably be interpreted, and in relation to what. This is a pragmatic approach, rather than a positivistic one. Whether the subject matter is actually real or constructed as real is unimportant in this case, beside the degree to which consensus is reachable about its existence, function, and utility.[106] The 'four foils' of pragmatism help steer clear of both positivism and determinism.

I propose, therefore, that part of the definition of disciplinarity should regard the disciplines as effects of the nature of the subject matter they study, rather than the subject matter being a social construction made within the discipline. The latter would suggest that a social cohesion without a subject of focus could occur first, and then within this subjectless social unit, a purpose is selected. Although such an origin is theoretically

[105] A dendrochronologist might make a case against this, but it is unlikely.
[106] I am at this stage presenting a Realist milieu. It is important to hold the sceptical and relativistic foils in mind when doing so, Realism being only a high-consensus short-hand.

possible, it seems wholly unreasonable, and there is simply no evidence of this having been the case (even a single clear example would be sufficient to refute a subject-centred theory). Which subject matters are most important and how they are categorised is another matter. The non-emergence of such a strong subject-matter-centred model recently though is perhaps understandable. It carries the unmistakable ring of positivism or determinism. The concern that such a position might open the door to determinism and isolationism between the disciplines is undoubtedly a consideration, though ironically, it is entirely to make a case against disciplinary isolationism that I propose such a model.

An awareness that the core of a discipline is a relatively unsupervised categorisation of optimal or 'natural' perceptions of subject-matter, rather than an agential constructivist choice made by the discipline as a social unit, may help remove the sense of protective ownership of the subject-matter that the latter can engender.

There is a caveat to this programme of disciplinary definition, however. It is not automatically clear that there *should* be a line drawn between the epistemic qualities of subject matter and the socially constructed aspects of disciplinarity at all. It cannot be stressed enough that the distinction is neither essential nor is it arbitrary, but instead it is empirical and useful. Epistemic qualities of subject matter appear to offer the most stable approach. This distinction, however, is not essential.

Recontextualising Fields

The disciplines are effectively the point where the uncategorised world gets converted into a human-understandable range of focused concerns/interests, and more importantly where this becomes teachable in effective units. It is a process of categorisation and translation: a 'recontextualistation'. To help define the functional implementation of disciplinarity, I will be employing the perceptual framework of Recontextualising Fields (RF) as developed by Basil Bernstein.[107] Bernstein refers to recontextualising fields as the space in which the undifferentiated external world becomes translated by pedagogic agents into a teachable

[107] I should be clear, however, that I do so because the concept of recontextualisation is compelling as an explanatory analogy, not because there is sufficient, or really any, empirical evidence to validate the model more broadly: it remains highly underdetermined. Bernstein's model could and should be tested in much more well-formed experiments than it previously has been (Bernstein, 2000). For example there are substantial problems with recontextualising fields as Bernstein depicts them because he sees these as spaces apart from application or doing. This obviously presents problems for work-placements or professional involvement in the curriculum (which Bernstein is at least up front with his disdain for), but also for more integrated practices such as research-teaching linkages and SoTL, both of which show considerable success as curriculum designs.

and learnable format. This is clearly an act of agential and supervised categorisation, and one based specifically on the expertise of the academics involved.

All of the social factors and societal needs/desires should inform the focus of what the discipline hopes to discover/create (the set of questions it hopes to answer), while the epistemic qualities of the subject matter should indicate a range of possible specific methods which might be effective for achieving that goal, as well as limiting what questions *can* be asked. In Trowler's words, "Artefacts, objects, things or tools - the language differs according to theoretical strain - can configure human behaviours, scripting them, but at the same time recurrent practices shape the way artefacts are deployed" (Trowler 2012b: 31). The two elements cannot produce disciplinary meaning in isolation, but rather must rely on a self-referential loop to constantly redefine the discipline each time either the social factors or the understanding of the qualities of the subject matter change; a process which is not only frequent, but which also has local, regional and international levels of operations to consider.

A discipline can be referred to as a Disciplinary Recontextualising Field (DRF) between the epistemic qualities of the subject-matter and the complex network of socially constructed aspects of disciplinarity.[108] The recontextualising concept represents a level of abstraction from both the subject matter and social networks both internal and external to the discipline in order to create a distinct definition of the discipline between these. By this abstraction, the definition can speak about the process of constant reconfiguration of these two elements in relation to each other in terms of a unified whole (the discipline) defined by this interaction, but importantly without subsuming either into the other holistically. The recontextualising field allows an insulating layer of understanding which permits reductive separation of the elements: an essential feature in order to contest ownership and essentialism in disciplinarity.

The subject matter plus the constructed focus as convergent soures of recontextualisation seems the most effective way to consistently clarify distinctions that separate disciplines, but interdisciplinarity, especially as filtered through categorisation theory, indicates that there is more to be said because different valid categorisations can cut right across each other.

[108] This is to be distinct from the Pedagogic Recontextualising Field (PRF) and Official Recontextualising Field (ORF) which Bernstein proposed. The PRF is similar, but it concerns a much broader concept of the curriculum in general.

Categorisation of Disciplinarity

In the interviews with medievalists, the largest overall trend about the nature of disciplinarity was that a discipline is an inherently vague, historically situated, constantly shifting instrumental social construction. These traits suggest that a discipline is chiefly an optimal or 'natural' pragmatic level of categorisation, the ideal balance of utility and simplicity that suits the most people in practice.[109] But because expertise substantially increases an expert's capacity for meaningful categories in the same domain, how much breadth or nuance this optimal category encompasses will surely be different between internal experts and external observers.

Laymen/novices will therefore see disciplines as simplistic, composed of surface features, mutually exclusive, and objective. Experts, however, can see their own and related disciplines as highly nuanced, open to debate, constantly in flux and with no genuine discernable core that is not related to other fields (ideally). In the middle fall the bulk of non-expert/non-novices that disciplinary experts will regularly encounter and who hold sway over disciplinary matters, such as university administrations, funding councils, and interdisciplinary team members from other fields. Based on Schunn and Anderson's (1999) research on hierarchies of expertise and much of the work on categorisation, these individuals should display some general understanding of the nuanced, permeable, non-objective nature and overlap between disciplines, but not as much as domain experts. The accounts of the medievalists I interviewed uphold this view well, demonstrating a sense of general uncertainty and constructiveness about all disciplines, but still retaining some notably objectivist stereotypes about other fields than their own, such as the views of several literary scholars towards History.

Some approaches to the categorisation of disciplines may be unjustifiably underdetermined; not all categories or definitions are equal. The on-going discussion of the disciplinarity or non-disciplinarity of various interdisciplines, hybrid disciplines, fields and studies such as Social and Economic History, Women's Studies, Area Studies, Medieval Studies, Classics, Biotechnology are all examples of this issue. These can appear intrinsically interdisciplinary when viewed through the lens of a fairly linear and uni-directional concept of disciplinarity based on the essentialist nature of mostly pre-1970 disciplines. However, these fields can just as clearly appear disciplinary when viewed from other

[109] It also suggests that the medievalists do not feel a sense of control or agency over the fate of their own disciplinarity.

perspectives, particularly any perspective which does not categorise disciplines as essentialist, mutually exclusive or uni-directional.

Which viewpoint should be preferred, and should these fields be considered interdisciplinary? Probably not, given evidence for the inherently interdisciplinary nature most ‘traditional’ disciplines from Classics to Physics, depending on which categorical perspective one chooses to look through (Piaget 1972; Thompson-Klein 1996; Moran 2010). Piaget on interdisciplinarity is important to recall here, that it is the idea of a truly ‘new’ and isolated discipline that is the chimera: no such thing has ever existed (Piaget 1972). Thompson-Klein and others have consistently agreed with this notion when discussing disciplinarity, but not later when discussing interdisciplinary (Thompson-Klein 1990, 1996; Bromme 2000; Moran 2010). What these new creations are instead is something that functions as a discipline, is regarded as a discipline, and yet is also inherently tied *in nomine* to the disciplines from which it arose, *without being beholden to them.* This does not seem like a good justification for a new type of disciplinary categorisation, but rather a more nuanced perspective disciplinarity which removes the criteria of uni-directionality and mutual exclusion from the properties typical of the category.

It is important to note here that the social influences of disciplinary tradition and external demands are not considered fundamental in this sense, as these should be simply recursively re-evaluating this basic process, and in each iteration either reinforcing or weakening a disciplinary category based on similarity or difference to a perceived prototype. This does mean, however, that disciplinarity is based on intersubjective consensus forming the prototype; each individual’s ideal notion of the discipline combined to create a socially constructed ideal form.

Ownership or Stewardship

In practice no discipline uses only one method, one theory, one process, or one tool, which would allow it to be defined solely by the focus of that element towards the subject matter. Further, no discipline ‘owns’ a method, theory, process, or tool. Some originate them though, and more often than not these disciplines become ‘custodians’ or ‘stewards’ of the these elements (often many of these), a ‘best fit’ for the place to look for the latest news on the subject or where to go if you want to learn it; the disciplines effectively become the first listing in the ‘phonebook of expertise’ or the first hit on a Google search.

An analogy can be made to journalism. A particular journal or news source does not actually own the event or subject matters that they report on, but those which are more specialised in a particular area will invariably be the best place to turn for the most up to date stories or the most in depth coverage on that subject. Several of the medievalists I interviewed mentioned this as a key element of good interdisciplinarity, awareness of the practices of other disciplines and knowing where to look or which discipline to ask about certain things. There was little, if any, implication of ownership involved in actual practice. This concept of ownership seems to appear in theory only, typically as a backdrop for developing a justification for interdisciplinarity.

For example, Gadamer suggested that historians do something more than literary scholars by looking at non-fictional sources for the meaning of the period and the situation around the text (Gadamer 2006: 331-2). This sort of 'ownership' of methods is the problem leading to pluralistic and essentialist interdisciplinary models. Historical research of the period and the author's situation and background is not 'literary scholars using history' it is a fundamental aspect of researching a literary work. It is indeed the same task that historians do, but it does not belong to historians to rent and sell. Historians merely develop the core of their group identity around specific approaches to certain types of historical objects as an optimal subject matter/focus category called a discipline. Historians are thereby identified as the foremost experts on the use of this category and all it entails, as well as stewards/validators of new knowledge and innovations in this area: they are the best people to ask whether your use of certain historical sources is good, but they do not own historical research practice.

Thompson-Klein in fact noted the same situation (that disciplines don't really own anything), but the solution was irresponsible and unnecessary. Ownership was to be removed to make way for interdisciplinarity, but no one was clearly left with the task of maintaining quality and reliability (Thompson-Klein 2010a: 7). The disciplines do house important communities of similarly trained experts who by virtue of the demonstrably more effective and reliable judgement of expertise can maintain stewardship over benchmarks, qualifications and standards for certain theories, methods and knowledge. This notion of disciplines as stewardship, rather than essentialist ownership or pluralistic/relativistic negligence, maintains a locus of responsibility for standards with those most qualified to set them. This represents a pragmatic *and explicit* weakening of borders *without* removing them, superseding them or making them inadvertently more rigid than before.This is where most IDS programmes and interdisciplinary curriculum

restructuring have fallen short, by releasing ownership, but with it also the responsibility to maintain qualified and recognised standards.

An important point in the approach to this issue is that Gibbons *et al.'s* concept of mode 2 knowledge was at least partially correct. We do appear to be moving towards a state of *more* holistic knowledge and understanding which expands beyond the old disciplinary knowledge-based model. Where I strongly differ is how to perceive this change in terms of curriculum. Mode 2 knowledge suggests we move beyond disciplinarity, and into a broader interdisciplinarity and trans-academic approach to knowledge with ties not only between disciplines but also with professional organisations. These are all good goals in themselves, but there is no clear reason why these require an abandonment of the structure that disciplinarity provides, instead of a more practical broadening of the practice and scope of the disciplines to replace ownership with stewardship.

By removing ownership from disciplinarity for one thing, we open up the allegedly cordoned off topics of ethics, writing skills, etc. to be a standard aspect of any and all disciplines, either embedded as graduate attributes, or generically taught. But by retaining stewardship we ensure that these topics remain the focus of locatable expertise and qualifications. It appears only to add unnecessary complication and identity struggles to suggest that every subject with a professional or 'applied' element must negotiate interdisciplinary relations with philosophy and creative writing in order to meet these goals. This denigrates each of these fields to little more than a supplier of employment skills training. But Philosophy and Literature should not suffer in any way from the removal of 'their' foci by allowing other disciplines to embed such features into the core learning objectives of their programmes. These things are not the disciplines themselves, but only something they specialise in. They remain the core stewards of excellence in these, and maintain the standards and benchmarks by which the teaching in other programmes should be measured, and that is all.

The second reason not to succumb to mode 2 considerations is that work-based learning is already a prominent feature of many programmes, and is becoming more so, even in the humanities, but this does not for any reason require removing the essential foundations of

quality standards and expertise development that the structured pedagogic system is designed for.[110]

Ultimately, a discipline or disciplinarity does not appear to be best served by a single short definition. This would leave too many important aspects open to confusion. Instead I offer the following elements of a complete picture of a discipline:

- *A discipline is a space wherein the combination of epistemic qualities of subject matter and the focus of inquiry about these become translated into teachable and learnable format.*

- *A discipline is a structure around which expertise can be developed, by means of which expertise can be located, and through which stewardship of trustworthy standards can be maintained.*

- *The same discipline serves different purposes and has different apparent properties based on level of subject expertise and the relative perspective of the observer.*

- *A discipline need not be mutually exclusive of other disciplines, and can intersect with aspects of other disciplines and in any number of directions.*

Interdisciplinarity

> "We should at least be open to the possibility that some aspects of interdisciplinary research look a lot like disciplinary research" (Szostak 2002: 104).

A large amount of what many call interdisciplinary is an unnecessary or unhelpful distinction because it fails to cross any discernible threshold into a new type of structure that would justify a different name or consideration; interdisciplinarity instead is what happens when a threshold of some kind is crossed (Land 2012). I propose that this threshold is reached when the individual ceases to be able to hold or develop sufficient expertise in all theories, methods or knowledge presumed to be needed to answer a problem (applied or theoretical) to provide the depth of answer desired within the time

[110] To be quite fair to Gibbons *et al.* though, their assessment of mode 2 knowledge appeared in 1994. The ubiquity now of what they discussed then could be a result of the very discussion they began.

allotted. *This makes interdisciplinarity not really a matter of disciplinarity at all, but a matter of professional collaboration and teamwork.* Scholarship on interdisciplinarity has consistently demonstrated that loose definitions, fuzzy borders and extensive theory, knowledge and method 'borrowing' have long been basic aspects of disciplinarity, but without appearing to substantially undermine the disciplinary structure or divisions (Lattuca *et al.* 2004; Thompson-Klein 1996).

Competency Models and Development of Expertise

Competency models of interdisciplinarity, be they IDS programmes or new thematic restructuring of universities, fail to deliver useful and trustworthy levels of expertise in students. This is not to say that there *cannot* be a standard qualification for IDS programmes, or that thematic universities *could not* develop an approved standard which is recognised beyond their own walls, but in neither case has this happened.[111] Without this, such programmes produce graduates with no consistently recognisable qualifications beyond the surface concept of the programme as interdisciplinary. As such, the students cannot be reliably located as stewards of more than an inconsistent concept of broad learning. A deeper and more troubling problem with such programmes is that they cater to the overconfidence aspect of expertise by instructing students to have confidence in a level of expertise at discipline-specific skills and knowledge, which they do not possess (Feltovich *et al.* 2006: 58).

This appears to be an aspect of the dichotomy of experts being better at self-monitoring, but also overconfident and biased. The problem is rooted in the perceptions of self, social responsibility and the nature of knowledge that the expert has been trained to have. If the expert has been trained to believe that being an expert means dealing with uncertainty and knowing the limits of one's abilities, then it is the increased self-monitoring that we can expect to see develop. If, as in competency models, they have been trained to believe that being an expert means having the answers, then overconfidence and bias is more likely to be the result (Schommer-Aikens 2004). Moreover, as Chi has noted that experts are biased and context based even within their already narrow range of expertise, it becomes apparent that both traits can be present in any expert, depending on the specific nature of a problem. The same doctor may consider a social situation involving other doctors to be open to uncertainty, but a diagnosis within their own specialty to be absolute (Chi 2006: 26).

[111] There has been some call for standards and textbooks of IDS programmes, but this has not produced much of a result so far (Repko 2006b).

At the University of Melbourne one response to the criticisms of the lack of recognised qualification for undergraduate students was that enculturation into a field or discipline did not begin until the postgraduate level (Davis 2011). It could be argued that the premise of enculturating students to a discipline if they do not intended to continue with study is actually not in tune with the practical working world or the novice level of skill expected from undergraduates upon completion, and this is reasonable considering that most graduates do not continue to further academic study. The promises of distributed expertise in interdisciplinarity fail, however, to address several critical elements of the research on expertise, and instead offer a form of *false economy* which may be suitable for some few special cases, but is not what it is advertised to be. There is more to the completion of a novice level of expertise in a field than only enculturation, although this alone can have profound implications for the later application of the skills learned, especially if the process is incomplete. The notions of 'minimal understanding', 'adequacy' and a lack of development of primary source research or evaluation skills that competency interdisciplinarity fosters leave even novice graduates of such programmes insufficient in most broadly recognised basic skills of other graduates of the same level: the models fails students.[112]

The ambiguous term 'interdisciplinarian', often used to describe IDS graduates, should be reserved then for an expert in interdisciplinary research team leadership: an academic project manager. "Researchers who develop a career working on such projects build up expertise on the integration of disciplines in a range of contexts and the management of other researchers from different disciplines working together" (Bruce *et al.* 2004: 460).

Polymathery and Transactive Memory

Interdisciplinarity is not knowledge and problems which exceed the grasp of a single discipline; as we have seen, the notion of a single discipline is simply not concrete enough on which to ever base such a notion. Rather interdisciplinarity occurs when the capacity of a single *person* is exceeded.

> "The implication is that the path to interdisciplinarity can be found not in arguing about theoretical balance and who sets the research agenda, and not in finding a methodology that lies somewhere between the two disciplines [history and archaeology], but in admitting the limits of individual knowledge and actively creating opportunities for exchanging ideas and sharing developments between different specialists" (Devlin 2009: 73).

[112] For details of what is expected in a general sense of graduates see the SCQF descriptors for level 10 in Appendix II

This is where a controversial but highly necessary distinction between polymaths and interdisciplinarity needs to be made. The question is one of the levels of expertise required or expected. A polymath will not have the same degree of expertise in all fields with which they are familiar as a team of equivalently trained experts in each of those fields will. More importantly, the polymath can only study one subject/problem at a time. Often a polymath will be highly trained in several fields, but may not have engaged with one or several of them for some time, sometimes years. A team of experts, however, will each be more current in their understanding of their separate fields.

If someone does 'interdisciplinary' work by themselves it can only be one of two things, work done without the degree of expertise typically expected of work done at the same level in a single field in the same timeframe, or work done by someone who has put in substantial extra time to become expert in all relevant fields. In the first case we would expect a skilled researcher to make a note of the limits of their knowledge in areas outside of their expertise areas, rather than allowing us to presume that they are an expert or have collaborated with one. To do otherwise is simply poor scholarship and unethical. Good peer-review is intended to uncover this, though in interdisciplinary situations this can be problematic (Huutoniemi 2010: 2012). In the second case, it would be true in one sense to say that a process of interdisciplinary integration is taking place within this researcher's mind, but this is not similar to the process of collaborative interdisciplinary work or a TMS. In the former the expertise in question is contained within only one person's prior knowledge and epistemological viewpoint; we lose the additional input of more viewpoints from which to negotiate an intersubjective consensus. Further, this work can only extend to fields this person has expertise in; collaborative interdisciplinarity is not limited in such a way.

Both the nature and benefits of TMSs compared to solitary work (and less structured collaborations) suggest that these cannot credibly be seen as the same thing in terms of interdisciplinarity. The development and functional processes of, as well as what we can expect from, interdisciplinary collaboration are qualitatively different from what we can expect from an individual attempting the same things. In fact it is unreasonable, especially in terms of policy and curriculum design, to refer to these as the same thing at all. Teams are more flexible in that they can expand to cover more fields by adding new experts, and can replace a less than effective member if need be. Teams also benefit from consistently upgraded disciplinary expertise, presuming they are developed from current experts in each

field required. Further, teaching interdisciplinarity would be an entirely different construct for developing a single practitioner who must be trained in several disciplines, versus developing collaborative skills alongside expertise in a single field to facilitate collaborative interdisciplinarity. Via transactive memory systems, interdisciplinarity can create a level and type of expertise not possible in a single person. Further, since knowledge transfer is an issue of encoding (chunking) and memory, and TMS has been demonstrated to increase these in a collaborative setting, then collaborative interdisciplinarity may stand to increase group *and* individual knowledge transfer at once.

Thompson-Klein illustrates the difference between a collaborative approach to interdisciplinary flexibility and the long road of the polymath in her account of solitary interdisciplinary researchers (Thompson-Klein 1990: 184). The researchers she consulted specified the importance of relying on consultation with others, developing an interdisciplinary portfolio over 10-30 years of study and practice, intentionally narrowing the field of consideration in some disciplines, and taking regular leave from disciplinary activity to renew/gain other expertise as needed. Several of the medievalists I interviewed had similar stories of having slowly developed expertise in more than one discipline over long years of effort. Further, several stated that this was the only way a single person could be interdisciplinary, and that this continued to be limited in scope.

Referring to these paths by the same term creates a single category, which is measured (ideally) by its output but which has two distinct valid output types, which are not comparable. It is not incorrect so much as confusing in terms of peer-review and expectations; it is poor categorisation. We already have a functional term for solitary interdisciplinarity, polymath. I propose that it is essential to teaching and developing real and effective interdisciplinary solutions for the next generation and beyond that we use both terms in the right places, and stop muddying the waters.

[put this bit into the methodology]

Transience and New Disciplines

Much of my early research for this thesis was spent attempting to rationalise a multi-tiered model of disciplines, specialisations, hybrids, interdisciplines, studies, and domains. It was only through repeated failures to be able to find a description of the differences which could prove both useful and consistent that I eventually moved away from this notion to adopt the stand that interdisciplinarity is transient, and is not well defined as anything that

endures in a new or unique form for long (although there can be prolonged cases as we will see when considering Medieval Studies below).

This is not to say that there are no 'real' interdisciplinary activities, situations or structures. Rather I am suggesting that these are temporary. We can therefore speak of *an* interdisciplinary project or *an* interdisciplinary field/study temporally situated, but not of these as being interdisciplinarity itself. In categorical terms, interdisciplinarity is a prototype which itself does not have a 'real' existence outside of the unification of the defining properties of all exemplars.

If a social demand for the integration of the skills of several disciplines appears, and is sustained, a new expertise begins to develop, a new discipline emerges. One frequently cited analysis of this phenomenon is that of Joe Moran, who looked at the history of the development of Cultural Studies and several other disciplines (Moran 2010). His conclusion was that interdisciplinarity leads to new disciplines. Brack *et al.*'s account of Biotechnology pointed towards the same conclusion, though not according to the authors (Brack *et al.* 2010). Karin Widerberg discusses the disciplining of Women's Studies in Norway as a several decades long process of applied social pressure now culminated in a recognised disciplinarity at the national level, one which successfully stands alone while also interfacing with several other disciplines (Widerberg 2006). Thompson-Klein and others have consistently failed to present a definition or example of an interdisciplinary field which was not either recently formed, already effectively a discipline, or has since dissolved.

> "If...we understand disciplines to have their own legitimating structures, then the only approach to resolving the issue is with reference to some further, superordinate set of legitimating structures to which both parties would consent. But this would amount to an appeal to, or the creation of, a new discipline rather than a case of interdisciplinarity: (Rowland 2006:.90).

Interdisciplinarity as a standalone model forestalls the development of new disciplines which should be forming, and by doing so blocks the development of expertise, innovation and stewardship in those fields.

Transience, Disciplinarity and the Perfect (Medieval) Storm

Critical mass does not define a discipline, but it is a necessary condition for emergence.

Although I have made a case for the inherent impermanence of interdisciplinarity in higher education, evidence from my interviews and study of Medieval Studies does indicate that there can be cases where interdisciplinarity may be sustained for long periods without either dissolving or developing into a new discipline. Medieval Studies seems to be a sort of 'perfect storm' of sustained interdisciplinarity, at least for now. This same state of affairs does not seem to be evident in the literature around other fields, such as Women's Studies, Environmental Studies, Cultural Studies, or Biotechnology. This suggests that the concept of interdisciplinarity as transient is not strongly refuted by Medieval Studies, but that we cannot view it as a law, merely a pattern of praxis which has limitations and outlying cases of an otherwise central tendency of transience. If more detailed study of several other fields *does* appear to show the same results though, then my model must be rescinded or at least substantially re-worked.

In the case of Medieval Studies there is sustained academic concern for the topic as an integrated practice, but it has been argued in my interviews that the skills and knowledge base is too vast or inconsistent to be regarded as sufficient to create a separate discipline. That it could form a large discipline with specialisations by area and sub-set of periodicity was mentioned in a few interviews, but not explored in any depth; although existing disciplines and interdisciplinary specialisations such as Celtic Studies or Scandinavian Studies already appear to represent such cases in practice. Apparent in the subtext of the interviews as well was that much of the interdisciplinary work in the field is actually multidisciplinary or is related itself to specific projects, which are themselves transient.

There was a sense that, at the elite level of research work, the interdisciplinary connections were to be worked out personally. When presentation of interdisciplinary work to a larger audience was mentioned, the need to develop skills of integration became clear. Collaboration was distinctly seen as essential and commonplace by most participants, but some were not convinced that it happened as much or as well as it should. None suggested it was unnecessary or undesirable though. A few participants noted that it is feasible that in another generation or so postgraduates of today will consider themselves medievalists first, and not consider that there was a divided origin. At that time the field may start to more resemble a discipline.

Explicitly collaborative projects, particularly funded ones, are not yet a norm for Medieval Studies. This is less true of Archaeology in general though, and also appears to be changing recently across the rest of the disciplines as external funding requirements change

to mandate larger and more collaborative efforts even in the humanities (Bildhauer and Jones 2013). Only time will tell if this becomes a new norm, in which case we may yet see Medieval Studies develop a substantial disciplinary identity.

The Medieval Studies subject matter/focus range is far too vast for the kind of cohesion usually seen from a discipline at the undergraduate level. Categorization and expertise research both lead to this conclusion, and several statements from the interviews expressed the same view. The concept of 'natural' categories is important in this, because this suggests that there is indeed an optimal range of *relative* size and complexity of categories. In this case a discipline is the optimal size and complexity for the main category of academic classification, and a Medieval Studies discipline which successfully covers all of the geographical regions, the full time period, and each of the disciplinary approaches does not appear to match the size and complexity of other disciplines: it is bigger than the rest and therefore is atypical of the category.

Classics offers a good parallel to compare Medieval Studies against. Classics also covers a broad timeframe, but unlike Medieval Studies, the subject matter/focus matrix covers only two specific and related cultures (Greek and Roman), mostly one geographical region (Mediterranean), and two languages (Greek and Latin). Obviously this is a simplification, but I believe this does accurately address the core of the field. A similar arrangement exists for Celtic Studies, Scandinavian Studies, and Anglo-Saxon Studies.

In practice it is often the ability to enculturate new recruits that marks out a new discipline. Medieval Studies students are not granted several extra years in which to learn the same level of expertise expected of students in other fields, but in a broader range of subjects. This is another critical failing of competency models of interdisciplinarity, and the problem of too much surface learning was expressed repeatedly in the interviews as well as several other accounts of interdisciplinary activities in the Medieval Studies (Capper 2009; Devlin 2009; Holas-Clark 2009). Strong subject expertise was considered essential to interdisciplinary work by many of the participants. If three or four years of regular training can only produce a medievalist with a small range of the expected qualifications, then disciplinarity seems highly questionable.

Although the field may indeed still be simply too large to count as a discipline, it may be able to function effectively as an umbrella field not unlike history or archaeology, as an element of a hierarchy of expertise/practice. I would agree with Chazelle and Lifshitz, as

well as comments from some of my interviews, that there should at least be a recognition of a skill-based/source-based split between early and late medieval studies (Chazelle and Lifshitz 2007). As with all other periodicity issues though, this is a vastly troubling point to demarcate, and once set it will only end up producing crossovers in short order. The presumption here is that 'Middle Ages' is the unified subject matter, but in practice this turns out to be too broad/vague a categorisation. Separating the specialisation in early or late medieval, however, does not invalidate Medieval Studies as a blanket for both. This may not be a problem for the future of a Medieval Studies undergraduate though, because the most common statement about periodicity in the interviews was that the 'Middle Ages' are a received category, and most participants were not comfortable with it in general. It is very reasonable that the period/region could be apportioned out in more optimal categorical chunks for undergraduate study. This has already occurred in fact in many of the aforementioned cases, often of regional or institutional interest (Celtic Studies at Glasgow, Scandinavian Studies at Aberdeen).

There remains a call for Medieval Studies at the postgraduate level, but at this level there is a new feature involved; the participants can be expected to have a higher level of initial expertise, in terms of subject knowledge, but also more complex chunking capabilities and intrinsic interest.

Finally, Medieval Studies appears to have a relatively low sense of urgency about the subject matter in a broader social context. In contrast, such fields as Environmental Studies, Area Studies, Cultural Studies and Gender Studies have since their beginnings been charged with periodically renewed senses of social and political urgency. A lack of substantial presence for Medieval Studies in non-elite, non-research intensive universities can be seen as some evidence of this. This external force can help push a field towards greater degrees of selective attention and integration, effectively trimming off non-essential aspects of cognate disciplines until an optimal subject matter/focus can be reached to meet the demand for graduates as Widerberg demonstrated for Women's Studies in Norway (Bernstein 2000; Widerberg 2006).

Interdisciplinary Is...

Interdisciplinary practice described as inherently transient means it can no longer be effectively defined as a stand-alone academic entity/identity. This narrows the options for how to define it. Thompson-Klein and some others have suggested that interdisciplinarity is best seen as a process (Thompson-Klein 1990; Newell 2001; Szostak 2002; Repko 2008).

This is compelling in terms of interdisciplinarity as a research or project-based activity, and it is consistent with most descriptions of interdisciplinarity in practice, including the medievalists interviewed here. There are problems with defining interdisciplinarity as a process, however, which are similar to defining a discipline as 'approach to evidence': each is correct and effective to a certain degree, but each is insufficient to ground a definition or curriculum model on except in a pluralistic or case by case basis. Further, the process models offered by William Newell and Rick Szostak have been criticised for being both incoherent and effectively impossible for all but the most dedicated and elite polymaths, especially considering that each model is meant to be performed by a solitary researcher (Bailis 2001; Carp 2001):

> "A. Drawing on disciplinary perspectives:
> - *defining* the problem (question, topic, issue);
> - *determining* relevant disciplines (interdisciplines, schools of thought);
> - *developing* working command of relevant concepts, theories, methods of each discipline;
> - *gathering* all current disciplinary knowledge and *searching* for new information;
> - *studying* the problem from the perspective of each discipline; and
> - *generating* disciplinary insights into the problem.

> B. Integrating their insights through construction of a more comprehensive perspective:
> - *identifying* conflicts in insights by using disciplines to illuminate each other's assumptions, or by looking for different terms with common meanings, or terms with different meanings;
> - *evaluating* assumptions and terminology in the context of the specific problem;
> - *resolving* conflicts by working towards a common vocabulary and set of assumptions;
> - *creating* common ground;
> - *constructing* a new understanding of the problem;
> - *producing* a model (metaphor, theme) that captures the new understanding; and

> *testing* the understanding by attempting to solve the problem." (Newell 2001: 15)

> 1. "Start with an interdisciplinary question.
> 2. Identify the key phenomena involved, but also subsidiary phenomena.
> 3. Ascertain what theories and methods are partially relevant to the question at hand. As with phenomena, be careful not to casually ignore theories that may shed some lesser light on the question.
> 4. Perform a detailed literature survey.
> 5. Identify relevant disciplines and disciplinary perspectives.
> 6. If some relevant phenomena (or links among these), theories or methods identified in (2) and (3) have received little or no attention in the literature,

the researcher should try to perform or encourage the performance of such research.
7. Evaluate the results of previous research.
8. Compare the results of previous disciplinary or interdisciplinary research.

Develop a more comprehensive/integrative analysis." (Szostak 2002)

Further, these models have been either derived from or have led directly to other process models by Julie Thompson-Klein (1990: 193) and Allen Repko (2008: 142) which have been described by these authors as iterative, able to be entered from any point, and able to be followed in any direction. This raises the question of how these qualify as processes at all, rather than merely checklists of things not to overlook.

Still, the notion of interdisciplinarity as a process is intuitively compelling. It would be better to say it is likely there is an optimal interdisciplinary process (or processes) in the sense that TMS research suggests there are optimal ways to develop effective collaborative structures. This would suggest, however, that the process is only part of what interdisciplinarity actually is, that the process is emergent from an understanding of the nature of interdisciplinarity. Interdisciplinarity in terms of something that can be developed up to a point where a process could be applied must be something else. I offer the following:

Interdisciplinarity is a domain-general set of basic skills for collaborative work across differentiated individual expertises.

What such a definition offers is a clear statement of all features which are essential to the nature of interdisciplinarity, while not constraining important but nonetheless emergent or non-essential features such as methods and pedagogies. These non-essential aspects which would be needed to develop practical curriculum are descriptive rather than definitive, and are therefore free to change over time as research on pedagogic practice and curriculum design develops. That is, the definition is simple, clear, and powerful enough to define what aspects of interdisciplinarity are essential, and to exclude most if not all concepts of interdisciplinarity which have not been supported by the evidence in this thesis. But it is also flexible enough to allow substantial pedagogic change over time. There is no requirement in this definition for disciplinarity to be an aspect of interdisciplinarity at all (raising the question of whether a different term might be preferred). Rather it is based on recognising the limits and differentiations of *personal* expertise. As we have seen, however, the disciplines represent the 'optimal' category of academic expertise classification, so

typically personal expertise will be in line with disciplinarity. As such, the term interdisciplinary should still be usable and effective as it is, so long as it is not taken too literally.

Interdisciplinarity is required by this definition to be collaborative, and as such most IDS and competency models are excluded from it. Because interdisciplinarity is defined here as a skill set it cannot be also defined as an entity with either permanence or identity. A person with training in interdisciplinary skills could identify as such, but only in relation to some type of personal (usually disciplinary) expertise which the definition also requires (e.g. chemist with interdisciplinary skills, environmentalist with interdisciplinary skills). Finally interdisciplinarity requires differentiated expertises by this definition, drawing directly from the research on transactive memory systems. It is the interdisciplinary skills, the accompanying perspectives on disciplinarity and the flexible application of these which are the *core and sustained* presence of interdisciplinarity.

This definition also strongly implies that interdisciplinarity could be a sub-set of graduate attributes. This was the intention, though this connection should not be mistaken for an essential one. It was compelling to include graduate attributes based pedagogic elements into the definition, such as that interdisciplinarity must be developed as embedded within the disciplines but also facilitated across them, as the research on cognitive entrenchment and knowledge transfer together suggest. This would, however, limit the definition to what appears to be the most effective and well supported pedagogic model at this time, and a newer a better model may appear at any point. The definition as it stands is free to meet this change. Nevertheless, there is substantial evidence from expertise research, transfer research, graduate attribute research, and other research on the critical thinking debate which suggests that a skill set which must be *originated and situated* in the disciplines to have context and deep meaning, but which then can be explicitly built-up as meta-cognitive, may be an effective solution. This was, for example, the approach to pedagogy of knowledge transfer that Lobato as well as Chi and VanLehn proposed; layering flexibility into developing entrenched expertise.

The actual skills which best comprise interdisciplinarity, and how best to implement them into the curriculum is the focus of the next section.

Interdisciplinarity in the Curriculum

Just as interdisciplinarity is not about integrating disciplinary knowledge but personal expertise, interdisciplinary curriculum designs are not about 'getting the disciplines to work together' but about producing new scholars who don't see this as work. With this as a goal, a curriculum for interdisciplinarity should aim to produce disciplinary qualified experts who can also engage in interdisciplinary activities without regarding this as an extra step of a hardship.

Failings of the competency approach to interdisciplinary curricula have been considered much in the previous chapters. Briefly, there are some other approaches to getting interdisciplinarity into the curriculum worth looking at. MacKinnon *et al.* (2010: 50) suggested that only those involved in a particular interdisciplinary project can make the determination about the success or context of interdisciplinarity, and that it is essentially impossible to make policy for interdisciplinarity because it is such a fluid concept. This ignores the intrinsic fluidity of disciplinarity, such that no two disciplinary projects are likely to be much alike as well, while this appears not to hinder policy. The authors resolve this by suggesting that specialisations are also a realm of interdisciplinary activity *within* the disciplines, and that policy cannot be made for these either (this likely derived from similar statements by Becher (1989)). This is a doubly essentialist approach in that it isolates the reliable and stable core of disciplinarity to an even smaller essential unit, while also creating a new essentialist microcosm for each interdisciplinary or specialised project undertaken. There is something to take from this account, however, which is that because interdisciplinarity is transient and project-based Mackinnon *et al.* are at least partially correct in saying that there are no benchmarks or quality standards for such work. Developing interdisciplinary curricula must look elsewhere than structuring interdisciplinary activity around qualifications which cannot be validated.

Alternatively, Thompson-Klein, reviewing the work of Veronica Boix-Mansilla and the Harvard 'Ground Zero' project on interdisciplinarity, has made some compelling and emancipatory statements about interdisciplinarity:

> New conceptual models and explanatory power provide feedback to and outcomes in multiple disciplines and fields. New integrative frameworks, methodological and empirical analysis, and research hypothesis enhance the study of particular problems. The scope and conceptualisation of research topics also broaden, and levels of analysis are bridged. Individuals' capabilities expand as they develop new expertise and research methods,

> work in more than one discipline or field, and collaborate in ID projects and programmes (Thompson-Klein 2010b: 142–3).

Thompson-Klein here is not referring to studentsor the curriculum though, but to the administrative and research activities of a select, already interdisciplinary, subset of late-career senior academics. This regards interdisciplinarity in a *post hoc* manner, as something to be administratively sanctioned for the practice of the elite among the elite, rather than something to be taught and practiced in the wider academic and working world. What appears rhetorically expansive and emancipatory is in fact anything but. This is not to suggest that either Thompson-Klein or 'Project Zero' are not interested in developing interdisciplinary teaching and learning, merely that the approach above has very little to do with students and learning theory, and more to do with developing secondary identities for existing staff.

In the models above interdisciplinarity is seen as only approachable by individual experts or teams on a case by case basis, such that no clear curriculum could be made to approach the development of interdisciplinarity in a more domain-general way. This is in contrast to the competency approach which generalises interdisciplinary curricula without considering the problems of qualifications or fit within existing staff workloads that the models above highlight. There is a 'middle-way' to approach the issue, though, via the naturalised pragmatic view on the epistemology of the disciplines with unifying elements such as the scientific method, hierarchies of expertise and shared knowledge. This approach looks to identify the problems of the other models and balance awareness but not acceptance of conflicting factors of each. Educational philosophers such as Ronald Barnett and Stephen Rowland have urged a similar approach, suggesting that the way to fostering a truly expansive, emancipatory, and useful higher education system is for each academic to embrace interdisciplinarity and complexity in education, to balance the paradoxes internally, and to constantly renew this effort (Gibbons *et al.* 1994; Barnett 2000; Rowland 2006). A compelling criticism of these accounts, however, is that this is not a practically feasible approach because it places more unregulated responsibility on a single staff member than could reasonably be met. Thompson-Klein's approach to administrative and staffing related resolutions to interdisciplinarity is not dissimilar. This is also the same criticism made of Newell and Szostak's process models of interdisciplinarity, which place a similarly excessive weight on the individual, in this case the student.

A way to address interdisciplinary curricula is needed which is generalisable while also recognising the need for standards and benchmarks, and which is structured and implementable in a reasonable manner by both staff and students in a practical setting. In the previous section I proposed that interdisciplinarity was a set of domain-general skills, and that in the current state of educational research the graduate attributes approach may be best suited to implement these skills. The development of graduate attributes in the curriculum has already encountered and developed some solutions to several of the same problems of quality assurance and evaluation as well as staff and/or student overload. These solutions are notably far from universal, complete or perfect though, especially in terms of implementation (Sumsion and Goodfellow 2004; O'Neill 2010; Barrie 2012). Simon Barrie has recently found that the problem of a plurality of approaches to graduate attributes may rest with the personal epistemologies (he did not use this term) of teachers and staff, who do not come to the process with the same understanding or beliefs in generalisable or flexible learning objectives, or who perceive development of these as someone else's job (Barrie 2012). Adding interdisciplinarity to this model may be the *best* approach, but it is not without work to be done or further solutions to be found.

Interdisciplinary Skills

The notion of 'interdisciplinary skills' has been present in the discourse of each RoI tradition since the beginning. It was present in the 1972 OECD/CERI report, it was present in William Newell's 1982 analysis of interdisciplinarity, it was strongly emphasised at the end of Thompson-Klein's 1996 work and many others (Rowland 2006; Devlin *et al.* 2009; MacKinnon *et al.* 2010). More recently it has been the conclusive outcome of Spelt *et al.*'s evaluation of the empirical work across the RoI field (2009). What has not manifested from any of this though, either in theory or practice, is a clear focus on how this concept relates to an actual pedagogic approach to interdisciplinarity, though Spelt and some others have recently been leaning towards this, I believe. The following are proposed domain-general interdisciplinary skills based on the evidence of RoIR studies, my own interviews, and the empirical work on expertise, transfer, and collaboration. These descriptions are not intended to suggest specific practices, which would need to be developed on a contextual basis by individual instructors or subjects

- **Stewardship & Mutual Respect:** Bruce *et al.* listed being a 'good team worker' as one of the key skills of interdisciplinary work (Bruce *et al.* 2004: 464). This requires developing the understanding that other fields can approach the same

problems and subjects from a different direction validly and with no less academic rigour or value. This also involves decentring the home discipline of the student, and making the notion of disciplinarity as stewardship more explicit by instructing students in the importance and responsibility of experts to maintain standards and develop new knowledge, while acknowledging the lack of ownership or control of this knowledge in an exclusionary way. Discussion of practical measures for conflict resolution could be part of this skill as well. This was specifically noted as essential for interdisciplinary project leaders in much of the RoIR research. As such, it may not be essential to more general interdisciplinary skills training, but this could be good knowledge for any student to have nonetheless.

- **Interdependence (interdisciplinary awareness):** A very strong trend across the RoIR studies and my own interviews was the need to be at least somewhat aware of which other fields exist and what they were about. In terms of interdisciplinarity as collaborative, this needs to be addressed as interdependence. It is this approach that can facilitate the shared goals and mutual responsibility that was considered essential for effective TMSs to develop. At least two medievalists specifically mentioned the American general education approach as superior in this regard. This may or may not be the best method, as it does not explicitly address interdependence.

- **Self-Monitoring (flexible personal epistemology):** Students must also learn an entirely new skill, the ability to recognise when they have the expertise to usefully integrate something themselves, and when they do not. This places the expert ability to self-monitor and be aware of one's own limitations as a key skill to be developed in undergraduates. In terms of the curriculum, this is a matter of developing/promoting a flexible *and explicitly understood* meta-cognitive personal epistemology, as Hofer suggests (Hofer 2004a). This was the most commonly cited skill needed for good interdisciplinary work in my interviews, and appears strongly in the RoIR studies by Griffin *et al.* and Bruce *et al.* William Perry regarded this as quite an advanced level of intellectual development, one which many undergraduates do not reach (Perry 1999). This would imply, if Perry is correct, that interdisciplinarity is not something undergraduates are consistently ready for, but Schommer-Aikens and Hofer's work on personal epistemologies suggests a belief rather than developmental base for this, and as such this should be a skill

which can be developed.

- **Common Academic Language:** This skill would need to focus on how to translate the ideas of one's own field, or any field, into a common dialect of academic understanding. Following from Schunn and Anderson's study, this would involve different specific knowledge in different cases, as some interdisciplinary communication could occur by stepping back to a less expert mutual domain level of training, but other cases would require translating back to the core principles of the scientific method as a common tongue. As expert language within a discipline is being developed, simultaneously attention should be paid to developing understanding of how this expert language can translate to understandable terms for non-experts, and how similar translation of expert language can be elicited from experts in other fields. This would include explicit development of the ability to recognise causal categorisation links or deep level interactions to other disciplinary concepts from deeper knowledge of one's own discipline, as Lobato as well as Chi and VanLehn have suggested to facilitate knowledge transfer while retaining expertise. Notably this does not mean developing a sense of translating from other disciplines oneself, this is a chief fault of competency and solitary interdisciplinary models. Because collaboration and shared goals are assumed in the definition of interdisciplinarity, it is how to translate one's own expert language to a more shared level of understanding for others that is key.[113]

The Interdisciplinary Curriculum in Concept

The next step in creating an interdisciplinary curriculum is to consider how such skills can be added to the curriculum. There are two stages to this: conceiving of how interdisciplinary skills fit into the curriculum as an abstracted notion, and considering how this can be applied to practice. A common presumption of much of the HTRoI literature, and especially transdisciplinary literature such as Mode 2, is that the goal of education is moving towards becoming more interdisciplinary, and that a uni-directional progression towards this is the ideal. This notion is also tacitly present in some of the educational literature, such as Barnett and Rowland's accounts of the changing university. A unidirectional shift from disciplinary focus to interdisciplinary focus (figure 7.1) is only a

[113] A similar-seeming notion has been proposed by Allen Repko as finding 'common ground', but the evidence and recommendations are misleading. Repko's analysis hinges on a fabricated dichotomy in the interdisciplinary literature and a surface 'folk-psychology' understanding of the principle of 'common ground', such that the bibliography includes only one questionable source on psychology of any kind (Repko 2007).

partial understanding of what the additional evidence reviewed here suggest as the more complete perception.

Here the perspective is meant to shift from single-discipline contextual learning to interdisciplinary decontextualised or broadly contextualised learning. Clearly though, several of the skills in each are comparable and interrelated, such as ‘ethically aware / global citizens’ and ‘stewardship’ or ‘interdependence’. These appear to be simply different ways to state or approach a very similar core skill. The real difference between the two sets is not the *nature* of practice but whether skills in a broad context, or knowledge in a narrow context is the focus. Categorically, the degree of knowledge and expert language required in all fields available during an undergraduate degree far exceeds what a single category can cover for a single student, however, a small set of applied skills does not.

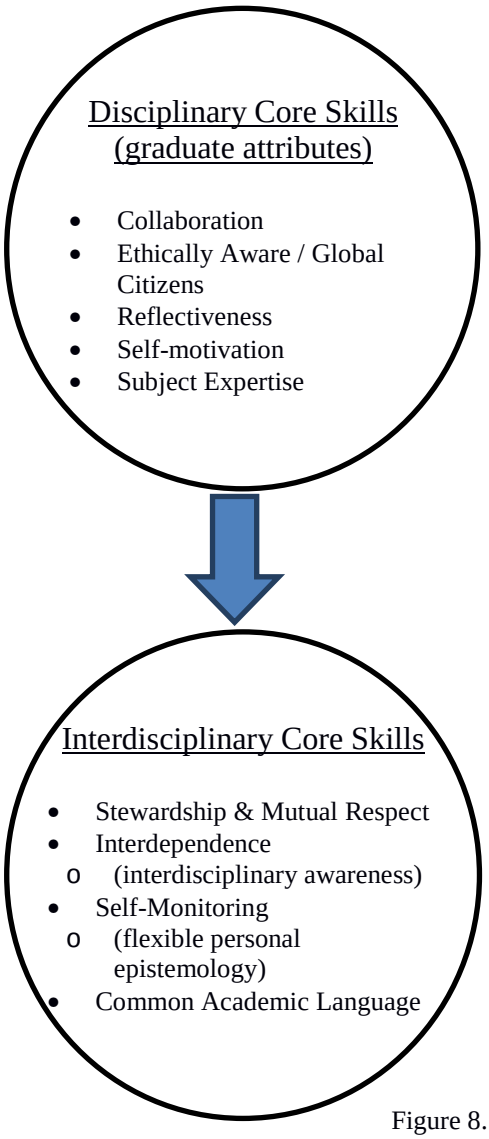

Figure 8.1 Partial Pedagogic Model

Additionally, IDS, Mode 2, and many other approaches to interdisciplinarity have set it aside from disciplinarity by virtue of its more applied focus, the disciplines being 'pure'. But we have seen that there is substantial reason to doubt that such a dichotomy makes sense in a broader context. The notion is refuted by expertise research, such that the concept of 'pure' research means only that its application is less clear to non-experts, and also by knowledge transfer research, such that it is unclear in any case whether 'pure' knowledge is 'transferred' or all knowledge is simply 'applied' differently. Requirements for impact statements in research, as well as problem-based learning and work-placements becoming increasingly commonplace even in the humanities suggests the same lack of any real applied/pure dichotomy from an educational practice perspective.

Recalling that transactive memory systems appear to accurately and effectively describe interdisciplinarity, but that TMSs also describe effective collaborative work within the disciplines (page 125), a different way to look at both disciplinarity and interdisciplinarity in pedagogic terms is as two *perspectives* on similar meta-skills of meaning making and practice (figure 7.2). This suggests that it is not a progression from disciplinarity towards interdisciplinarity that should be the focus, but a medial point where both approaches converge on a more complete understanding of knowledge construction and each student's individual and interdependent place within this. The two approaches more correctly represent a balance of necessary curriculum/perspectives to reach a functional individual *and* collaborative practice, the central point being the construction of a TMS framework.

Notably, this approach requires a potentially controversial approach to individual academic work: that there is really no such thing in actual practice.[114] There is considerable support for this notion, however, in both the nature of the scientific method, such that it prohibits individual assessment of one's own work and requires replication and peer-review, as well as from categorisation research in that there is little to no possibility for actual unsupervised categorisation after quite an early stage of development: our categories and approaches to knowledge are intersubjectively developed and confirmed. In more educationally focused terms this notion is clear in the historian's notion of 'collaborating with the dead', the idea that the researcher engages in a dialog with the sources and with

[114] It is of course still feasible and perhaps useful to distinguish active and passive collaboration, the latter encompassing the 'solitary' work of academics. The application of interdisciplinary skills should not be effected by such a distinction though, and are still essential for a more complete approach to knowledge production in either case.

past research (Gadamer 2006; Gunn 2014). Indeed, several of my interviews also raised the notion that ‘collaboration’ included working from the published work of others, or that it could. This concept is also present in the notion of science as a progression of cumulative knowledge. Although Thomas Kuhn’s analysis of paradigms disrupted the notion of a genuinely cumulative development across all science, it was still clear that each paradigm was itself cumulative and inherently collaborative (Kuhn 1996). The distinction in pedagogic terms then is not that interdisciplinarity is collaborative and disciplinarity is not, this should be clear in the common disciplinary graduate attributes of ‘collaboration’ and ‘communication’. The difference, which forms part of the definition of interdisciplinarity above, is that one involves a skill-based perspective for working with problems that exceed personal expertise, and the other involves a skill-based perspective for working with problems which do not. There is clearly still considerable grey area even in this notion, which is another reason that an explicit convergence of disciplinary and interdisciplinary focused skills and teaching should be preferable to preserving another false dichotomy like hard/soft and pure/applied.

The two perspectives on the skill sets to develop are differentiable in practice by the focus of the curriculum, i.e. what aspect is foregrounded. On the disciplinary side of the equation the focus is on specialised (though not totally isolated) disciplinary contextualisation. The immediate knowledge context, disciplinary ways of thinking and practicing, and development of nuanced chunking and expertise within this are the foregrounded goals. The approach to abstract skills is therefore broad and implicit as a background to this focus, and meaning making is content and knowledge driven. Conversely, interdisciplinarity is a generalised (though not entirely generic) abstraction of knowledge across disciplines, using interdisciplinary skills to translate deep structures into coherent interconnections through collaboration. The broad context allows the focus to shift to a narrow and explicit concentration on meta-cognitive and abstract skills, and meaning making becomes method and practice driven. A complete curriculum model of undergraduate learning must include both, not in opposition but in harmony, towards a goal which lies between.

The Interdisciplinary Curriculum in Practice

The focus of this thesis has been on developing a definition of interdisciplinarity and the broad pedagogic and curriculum model above. An in-depth approach to specific curriculum recommendations would require substantially more research into the empirical pros and cons of various curriculum models, as well as considerable attention to the administration and assessment of interdisciplinarity at the undergraduate level. These have not been the focus here, as this would easily be a thesis unto itself (and likely should be). This does not mean, however, that there has been no consideration of or evidence for curriculum recommendations throughout this research. For example, one question in the medievalist interviews specifically addressed curriculum models for interdisciplinarity. But this was only within one field, and responses clearly related only to a particular type of interdisciplinary implementation (an 'amalgamated' field wherein there are existing courses and staff that could be co-opted). As such this cannot credibly be generalised without much more study.

This section offers some more specific curriculum recommendations which are based on substantial evidence from the research above, but not yet the degree of evidence that we should feel comfortable to generalise policy on. The recommendations are abductive, in that they establish hypotheses of curriculum models to be tested, a roadmap for future research. It is the testing of these recommendations in practice across a wide range of subjects and environments, as Bamber's triangulation model suggests, that would be needed next.

When considering a practical curriculum, the time, will, and ability of those involved are the key issues, and playing to the central tendency is what is needed to develop reliably effective educational policy. While we can acknowledge the happy existence of truly gifted students, or of people willing to be in training for a decade before working, it is the average level of commitment, ability and time that the majority of university students have to offer that is what policy and theories must be based around. This has not gone entirely unnoticed in the RoI literature, "The importance of time repeats. It takes time to gain new knowledge and skills, develop relationships with colleagues in other disciplines, and learn their language, cultures, knowledge, and evaluation methods" (Thompson-Klein 2010a: 146). Thompson-Klein's solutions though, as we have seen, focus on administrative offerings for dual-purposing of staff. I do not see this as feasible, in fact it is likely a significant factor in the steady demise of IDS programmes. Thompson-Klein and others

have identified neo-liberalism and administrative disinterest instead for the failure of IDS programmes, but there is little evidence offered.

It is the incoming generation of students who have *relative* time and opportunities to develop interdisciplinary capacities, not the already overstretched existing staff and departments. This does require taking the long view of interdisciplinarity as something we foster now so that it may become the norm tomorrow. It is not a quick fix, it is a fix that is intended to last and be self-sustaining. As the new generation moves into the academic and professional world the new perspectives and skills they have developed will, with time, disseminate outward through example. Certainly some existing staff will hold out and never change, something Kuhn made clear is an inevitable aspect of any paradigm shift, and which Barrie has shown evidence of in dealing with graduate attributes as well. Some experts will be those who are entrenched, inflexible, overconfident and uncritical. But others will undoubtedly be those who are keenly aware of their limits and will welcome integrating new insights.

The following are recommendations for curriculum approaches to implementing and fostering interdisciplinarity skills at the undergraduate level. They are intended as domain-general; that is, they should work for any field. Further, although the Scottish higher education system has been my model, these should be applicable to any Anglo-American system, and likely beyond. Different possible options are presented in order to create an interdisciplinary curriculum ‘policy toolkit’ to allow the best option suited to a particular institution to be applied. No single recommendation is likely to produce a complete development of interdisciplinary skills alone, rather they should work best in concert as the situation allows. The recommendations are based on the centrally focused abstracted model of interdisciplinary curricula above, but with consideration of the problems of time, will and ability to implement them.

Fully Embedded Skills	10% Honours Requirement
In this model, the interdisciplinary skills are integrated fully alongside an institution's existing graduate attributes, becoming part of the same. As graduate attributes more broadly are embedded within the subjects, this allows for the skills to be placed within a subject expertise context at all points. In terms of entrenchment and knowledge transfer, this allows simultaneous cumulative development of flexible thinking and connective breadth as well as more narrow and nuanced subject knowledge. This process could allow the skill of translating understanding into a common academic language to be developed as expertise develops, which may be the only reasonable way to do so. Adding yet more domain-general skills to the often already overloaded learning objectives of each module could make an implementation of this model difficult. This model is also substantially staff dependent, something that was already noted as a problem with other models such as the similar approach to interdisciplinarity by Rowland. Staff development would be necessary. Although not every skill would need to be developed in every module, the flexibility of student pathways often makes addressing the skills at a particular point that all students will encounter also problematic. Combining of this model with a required interdisciplinary module (see right panel) may aid in this. Also a process known as curriculum mapping and assessment blueprinting (CMAB) may provide some solutions (see below). **Pros:** • Builds maximum flexibility within entrenchment throughout degree • Teaching focus stays within subjects **Cons:** • May overload learning objectives • Highly staff dependent	This model aims to address the learning objective and course load burden of full embedding, by providing a focal point of practice in the form of a required interdisciplinary component to all honours degrees. By requiring that 10-20% (1-2 modules) of each student's honours course load to be explicitly interdisciplinary, this would create a context in which to focus on interdisciplinary skills. Another benefit to this model is that each subject can make connections and design the courses as suits them, keeping the control of the curriculum largely at home (or shared between chosen coordinators at least). This could not be done without some oversight, however, in the form of periodic reviews and the requirements that the interdisciplinary skills be made explicit in the module. There is a likelihood that some subjects would take the 'easy way' and coordinate with very 'near' fields, thereby limiting the degree of useful interdisciplinary skill development. Incentives or even a requirement to coordinate outside of the same college or school could mitigate this without removing too much subject autonomy (Thompson-Klein 2010a). This model also does not itself provide any cumulative development of interdisciplinary skills throughout the degree. For this reason this model is best considered as an addition to the fully embedded model. **Pros:** • Most control remains within subjects • Ensures practical interdisciplinarity with personal expertise **Cons:** • No progressive/cumulative skill development • May allow too much entrenchment • Subjects may pair only with 'near' subjects without incentives

Subject Internal Module	**University Centralised Module**
This model recommends a specialised module or optional personal development session focusing on the interdisciplinary skills and taught exclusively within the subject (Chanock 2010). The subject centred focus clearly presents problems for interdisciplinary skill development in a broader sense as it does not directly involve other subjects. This model is not recommended as a stand-alone option unless other options are not available. That said, it does offer the benefits of keeping control of the curriculum almost entirely within the subject, and with providing the maximum subject-specific context for interdisciplinary skills. It is anticipated that such a module or optional session would be available early in the undergraduate career, but this is not required. It is also expected that this would be approached as a one time offering, but it could conceivably be a cumulative extracurricular process, such as a personal development portfolio which has been suggested as one means to implement graduate attributes as well. If this model were approached as an early one time module it could coordinate well with the honours requirement model above. If offered as a cumulative portfolio or series of sessions, it could be seen as an implementation of the fully embedded skills model instead. All three models together could offer a substantial development of interdisciplinary skills without sacrificing disciplinary expertise, but the staff and curriculum load to create such a combination may be prohibitive. **Pros:** • Can be very embedded/content specific • Can be early, before entrenchment **Cons:** • Lacks actual interdisciplinary contact • If early, precedes expertise • Inconsistent quality standards	Another approach to developing interdisciplinary skills would be a centralised and non-disciplinary module or session. This option would develop a one-off module or series of generic interdisciplinary learning modules at the institution, most likely to be run by a centralised student development or skills learning unit. Not all institutions have such centralised capacity, something similar could be offered at the college or school level though. This would likely be an optional course, but could be required. William Newell's IDS programme implemented a course specifically teaching a process of 'integration' which was met with considerable student approval. Newell's study noted that students took well to the course, but that they suggested that it needed to be offered at the start of the degree, rather than at the end of final year, as was the case originally (Newell 2006: 93).[115] In general, evidence regarding generic instruction does not support this as the best option, but it may be one where other options are not available (Moore, T. 2004; 2011; Sumsion and Goodfellow 2004; Barrie 2006; Davies, W. M. 2006). There may be some benefits to a such an approach as well, if coordinated with other models. A centralised session could allow an eclectic and random mix of subjects to develop skills of working together, which could provide a more 'real-world' example of the interdisciplinary skills. Such a configuration could also lead to creative and unforeseen solutions. **Pros:** • Centralised quality control • Easy to make actually interdisciplinary • May elicit random/creative combinations **Cons:** • Minimal subject context • Short duration limits development

In all of the models proposed, qualification standards for interdisciplinary development would need to be explicitly addressed, especially for the subject internal and university centralised models. This will allow the reliability and credibility of such programmes to be understood outside of the institution itself, and is a key element to developing a sustainable

[115] This programme has since closed, but this aspect appears to have been well received at least.

and useful approach to interdisciplinary development. This is best done at the national level so as to develop some credibility and mobility of the programmes across institutions. Possibly the simplest way to acknowledge interdisciplinary skills development is with a standardised badged degree title (e.g. ‘History with Interdisciplinarity’). Such a standard would need to be benchmarked by an agency such as the QAA.

Alternatively, interdisciplinary qualifications could be facilitated at the national framework level and by an agency such as the SCQF. This would involve developing interdisciplinary framework descriptors to coincide with the undergraduate levels of study (levels 7-10). The QAA and the SCQF working together (or the equivalent agencies in other countries) could develop a broadly acknowledged standard for interdisciplinary skills to be developed, both as a framework requirement of all graduates and as an additional focus of some degree programmes. Notably, there has been no attempt to do something similar at the national level for graduate attributes, however, the SCQF descriptors map well onto the graduate attributes already, which may explain this.

Interdisciplinary Studies Repurposed

Two other recommendations offer some chance to ‘repurpose’ Interdisciplinary Studies or thematic competency based programmes. These recommendations are aimed at resolving the central problem of competency programmes: the lack of reliable qualifications.

Postgraduate as Undergraduate	IDS as 'Interdisciplinary Project Management'
Something which may be reasonable to consider in some situations is reserving subject-specific expertise development until the postgraduate level. Interdisciplinary Studies programmes could then be seen as an introduction to interdisciplinary skills and graduate attributes with a light grounding in a range of chosen disciplines, a grasp of the types of problems these can resolve, and how they can interact. *This would mandate postgraduate study.* Without this addition the programme is merely an IDS programme as any other. Effectively, this is the programme that the University of Melbourne has proposed (Davis 2011). Although this is not likely feasible in most cases, and has already failed in several as we have seen, it is conceivable that some very elite institutions or specialised fields could adopt such a programme if it were explicit and if effective qualifications were made transparent. **Pros:** • May be feasible for very elite institutions or specialised fields • Can allow intense focus on skills **Cons:** • Must take five or more years • In practice has often failed • Graduates who do not continue study have no qualifications	The learning objectives and stated aims of the IDS model in general could be adjusted to explicitly train students in coordinating, facilitating and leading interdisciplinary project teams, teams made of experts in other fields. This could turn a string of failures into a new field to fill a much-lamented gap in the professional world, both in academia and beyond (Bruce *et al.* 2004: 460; Griffin *et al.* 2006; Lyall *et al.* 2011: 36). The existing IDS approach to breadth without depth could be retained, but teaching would need to lead explicitly away from overconfidence in one's own interdisciplinary problem solving and towards negotiating the interdisciplinary problem solving of a team of other experts. This is not likely to be a popular recommendation among supporters of IDS programmes such as the AIS. **Pros:** • Likely ahighly employable as a stand-alone profession • Allows very explicit coverage of skills **Cons:** • Does not confer subject-based interdisciplinarity itself • May be resisted by IDS proponents • Many Business degrees may already cover this

Implementation through Curriculum Mapping

A separate movement in curriculum studies that has been running concurrently and seemingly oppositional to interdisciplinarity is that of curriculum mapping and assessment blueprinting (CMAB). CMAB seeks to create more efficient and effective teaching, learning objectives and assessment by mapping what is being taught in a programme over the full duration of a degree (Knight 2000; Gunn and Talbot 2012). The mapping ideally prevents overlapping or redundant teaching and assessment, while also making certain nothing is missed out; the goal is reducing both staff and student overload. The process typically relies on a siloed disciplinary approach in order to efficiently execute reviews and evaluations, often tied to Key Information Sets (KIS) and National Student Survey (NSS) data and disciplinary benchmarks.

The disciplinary focus of CMAB and the concept of rigid mapping within this framework may appear to limit the possibility of developing interdisciplinarity, as this would presumably involve connections outside of the disciplinary map. But the interdisciplinary curriculum recommendations above are designed to develop interdisciplinarity without the need to substantially disrupt disciplinary approaches to learning and teaching. As such CMAB may have potential to aid in the implementation of interdisciplinary skills as well. I have been involved recently in attempts to remove this barrier to mapping processes so as to make a possible connection between the benefits of mapping and interdisciplinarity. If a CMAB implementation were to include interdisciplinary skills as something to be mapped, and also included in each subject either an honours interdisciplinary requirement, subject internal module, or centralised module as described above, then concerns for overloading the curriculum with interdisciplinarity, and thereby leaving nothing left for a qualified subject-based degree, might be mitigated or even eliminated. Mapping to this degree is an involved process, however, and would be best done with substantial subject buy-in first (Galvin *et al.* 2013).

Limitations and Further Research

As was mentioned in the methodology, the interviews for this thesis were originally designed to be substantial enough to be a primary data source for an entire thesis. The relative weighting and analytic approach to them, however, changed dramatically when the thesis became more about interdisciplinarity and less about Medieval Studies specifically. As such, there is a great deal more that can be made of the interview data with regards to learning and teaching in Medieval Studies, as well as in the humanities more generally that was beyond the scope of this work. It is my intention to take up this task, after obtaining permission from the participants. The interviews as a primary focus contain a wealth of information about disciplinary identities in practice in the humanities, and specifically in research intensive HEIs. Further, with a notion of interdisciplinarity and disciplinarity now more firmly worked out, it is possible for me to use the interview data to peruse the original goal of this thesis: developing a practical interdisciplinary approach to undergraduate Medieval Studies (or suggesting that we should not do so).

Beyond the interviews, more rigorous and less self-identified historical assessment of interdisciplinarity and the disciplines would likely yield considerable insights to a richer understanding of interdisciplinarity in practice as well. The historical emergence of

disciplines in particular could be very useful research, especially comparing 19th century disciplinary development to post-WWII massification development and more recent post-modern developments.

If any form of new undergraduate curriculum of interdisciplinary teaching is implemented, it is clear that there will need to be a means to assess both the success of each student and the success of the programme. Assessment of interdisciplinarity was beyond the scope of this thesis as well, but it is an essential next stop for development of interdisciplinarity. Research on assessment within RoI literature is severely under-represented, and what little exists is not typically compelling (Ivanitskaya and Clark 2002; Boix Mansilla 2004; Klein *et al.* 2005; Repko 2006a). It is as though this is a subject that everyone is afraid to touch, perhaps with good cause. Because the stated aim of interdisciplinary work is to explore new integrated outcomes between developed and qualified disciplines or expertise, there are no clear experts or benchmarks to compare any results to. There is considerable work to be done in the field of assessment of interdisciplinarity.

Final Thoughts

This thesis has worked through several disparate fields of expert research, delved into the dark heart of epistemology, and challenged a number of popular and commonly held views about interdisciplinarity. This has been for no more profound a purpose than to develop a more coherent core model of interdisciplinary curricula for undergraduate study than has been presented thus far. When a field such as research of interdisciplinarity has so many conflicting and/or cross-combining theories and models, all of which seem to fit the evidence presented equally well, then it becomes necessary to find new evidence which can hopefully end the stalemate and confusion.

By referring to more empirical research on educational theory and disciplinarity, more historically solid foundations of epistemology and academic understanding, and several fields of psychological research on the capacities and methods of human reasoning, it has been possible to shed new light on some old ideas. Ideas such as pluralistic ‘interdisciplinarities’, essentialist ‘ownership’ models of both disciplinarity and interdisciplinarity, and notions of promoting interdisciplinarity in undergraduates via adequacy and minimal understanding, have all been found lacking in light of these new sources of evidence. At the same time, existing interdisciplinary models promoting interdisciplinarity as interpersonal academic skills, interdisciplinarity as a transient feature

of academic work, and the need for full disciplinary expertise, have been more empirically supported than before. Not only has this approach allowed for a more solidly framed definition of interdisciplinarity, but it has allowed also for a more solid definition of a discipline as well, one which retains its core nature at the optimal academic category without conflicting with the nature of interdisciplinarity.

With the curriculum models proposed here we may yet see the barriers of disciplinarity dissolve into an interdisciplinary future, as many transdisciplinary proponents suggests, but this may come to pass by making a form of disciplinarity without barriers stronger, not weaker.

Appendices

Appendix I

University of Glasgow: Graduate Attributes

<http://www.gla.ac.uk/students/attributes/yourattributes/>

Subject Specialists	Understand and respect the values, principles methods and limitations of their discipline(s)
Effective Communicators	Articulate complex ideas with respect to the needs and abilities of diverse audiences
Reflective Learners	Use feedback productively to reflect on their work, achievements and self-identity
Experienced Collaborators	Engage with the scholarly community and respect others' views and perspectives
Investigative	Are intellectually curious and engage in the pursuit of new knowledge and understanding
Adaptable	Experience multi-disciplinary and/or inter-disciplinary learning in an internationally renowned institution
Confident	Defend their ideas in dialogue with peers and challenge disciplinary assumptions
Resourceful and Responsible	Are experienced in self-directed learning and authentic research-led enquiry
Ethically and Socially Aware	Consider and act upon the ethical, social and global responsibilities of their actions
Independent and Critical Thinkers	Identity, define and assess complex issues and ideas in a researchable form

University of Aberdeen: Graduate Attributes

<Aberdeen http://www.abdn.ac.uk/graduateattributes/>

Academic excellence

- In-depth and extensive knowledge, understanding and skills at internationally-recognised levels in their chosen discipline(s);
- A breadth of knowledge, understanding and skills beyond their chosen discipline(s);
- An ability to participate in the creation of new knowledge and understanding through research and inquiry;
- A contextual understanding of past and present knowledge and ideas;
- An intellectual curiosity and a willingness to question accepted wisdom and to be open to new ideas

Critical thinking and effective communication

- A capacity for independent, conceptual and creative thinking;
- A capacity for problem identification, the collection of evidence, synthesis and dispassionate analysis;
- A capacity for attentive exchange, informed argument and reasoning;
- An ability to communicate effectively for different purposes and in different contexts;
- An ability to work independently and as part of a team;
- A diverse set of transferable and generic skills

Learning and personal development

- An openness to, and an interest in, life-long learning through directed and self-directed study;
- An awareness of personal strengths and weaknesses,
- A capacity for self reflection, self discovery and personal development

Active citizenship

- An awareness and appreciation of ethical and moral issues;
- An awareness and appreciation of social and cultural diversity;
- An understanding of social and civic responsibilities, and of the rights of individuals and groups;
- An appreciation of the concepts of enterprise and leadership in all aspects of life;
- A readiness for citizenship in an inclusive society

Edinburgh Napier University English subject group: Graduate Attributes

<http://www.napier.ac.uk/oldcontent/standoutfromthecrowd/Pages/SchoolSubjectGraduateAttributes.aspx>

Intellectual curiosity and autonomy

An English graduate will be able to demonstrate:

- Discernment in their sourcing of knowledge and developing their critical thinking and research skills.
- An ability to combine intellectual curiosity with creativity and innovation
- An ability to engage in critical thinking (i.e., skills in reasoning, analysis, and evaluation);
- An ability to undertake self-directed and managed research and scholarship
- A comprehensive and well-founded knowledge of the English discipline
- An understanding of how other disciplines relate to the English discipline

Intra- and entrepreneurship

An English graduate will:

- Have the ability to interact effectively with others in order to work towards a common outcome
- Have excellent communication skills that will benefit them in the world outside university as they encounter different communities and societies
- Cope effectively with uncertainty and have the ability to move between a wide variety of learning situations in terms of work, social responsibility and personal matters
- Be able to undertake effective teamwork and collaboration in a culturally diverse environment
- Be able to manage individual contribution to teams and to engage others in complex and demanding tasks

Ethical, social and professional understanding

An English graduate will have:

- An appreciation of the philosophical and social contexts of the English discipline
- A knowledge and respect of ethics and ethical standards in relation to their study of English
- A personal commitment to professional standards
- Ability to appreciate and adapt to different cultural environments
- An understanding of social and civic responsibility and a commitment to issues of social justice

Personal effectiveness and self efficacy

English graduates will be:

- Adept at time management and personal responsibility
- Highly skilled, reflective individuals who can generate ideas, apply knowledge into practical outcomes and adapt innovatively to a variety of environments within the workplace and beyond
- Positive and enthusiastic in their outlook,demonstrating a lifelong passion for learning and reflection

University of Edinburgh: Graduate Attributes

<http://www.employability.ed.ac.uk/GraduateAttributesFramework.htm>

Appendix II

SCQF Level 7

CHARACTERISTIC 1: KNOWLEDGE AND UNDERSTANDING

Demonstrate and/or work with:

- An overall appreciation of the body of knowledge that constitutes a subject/discipline/sector.
- Knowledge that is embedded in the main theories, concepts and principles of the subject/discipline/sector.
- An awareness of the dynamic nature of knowledge and understanding.
- An understanding of the difference between explanations based on evidence and/or research and other sources, and of the importance of this difference.

CHARACTERISTIC 2: PRACTICE: APPLIED KNOWLEDGEERSTANDING

Apply knowledge, skills and understanding:

- In practical contexts.
- In using some of the basic and routine professional skills, techniques, practices and/or materials associated with the subject/discipline/sector.
- To practise these in both routine and non-routine contexts.

CHARACTERISTIC 3: GENERIC COGNITIVE SKILLS

- Present and evaluate arguments, information and ideas that are routine to a subject/discipline/sector.
- Use a range of approaches to address defined and/or routine problems and issues within familiar contexts.

CHARACTERISTIC 4: COMMUNICATION, ICT AND NUMERACY SKILLS

Use a wide range of routine skills and some advanced skills associated with a subject/discipline/sector, for example:

- Convey complex ideas in well-structured and coherent form.
- Use a range of forms of communication effectively in both familiar and unfamiliar contexts.
- Select and use standard ICT applications to process and obtain a variety of information and data.
- Use a range of numerical and graphical skills in combination.
- Use numerical and graphical data to measure progress and achieve goals/targets.

CHARACTERISTIC 5: AUTONOMY, ACCOUNTABILITY AND WORKING WITH OTHERS

- Exercise some initiative and independence in carrying out defined activities at a professional level in practice or in a subject/discipline/sector.
- Accept supervision in less familiar areas of work.
- Exercise some managerial or supervisory responsibility for the work of others within a defined and supervised structure.
- Manage limited resources within defined areas of work.
- Take the lead in implementing agreed plans in familiar or defined contexts.
- Take account of own and others' roles and responsibilities when carrying out and evaluating tasks.
- Work, under guidance, with others to acquire an understanding of current professional practice.

SCQF Level 8

CHARACTERISTIC 1: KNOWLEDGE AND UNDERSTANDING

Demonstrate and/or work with:

- A knowledge of the scope, defining features, and main areas of the subject/discipline/sector.
- Specialist knowledge in some areas.
- A discerning understanding of a defined range of core theories, concepts, principles and terminology.
- Awareness and understanding of some major current issues and specialisms.
- Awareness and understanding of research and equivalent scholarly/academic processes.

CHARACTERISTIC 2: PRACTICE: APPLIED KNOWLEDGE, SKILLS AND UNDERSTANDING

Apply knowledge, skills and understanding:

- In using a range of professional skills, techniques, practices and/or materials associated with the subject/discipline/sector, a few of which are advanced and/or complex.
- In carrying out routine lines of enquiry, development or investigation into professional level problems and issues.
- To adapt routine practices within accepted standards.

CHARACTERISTIC 3: GENERIC COGNITIVE SKILLS

- Undertake critical analysis, evaluation and/or synthesis of ideas, concepts, information and issues that are within the common understandings in a subject/ discipline/sector.
- Use a range of approaches to formulate and critically evaluate evidence-based solutions/responses to defined and/or routine problems and issues.

CHARACTERISTIC 4: COMMUNICATION, ICT AND NUMERACY SKILLS

Use a wide range of routine skills and some advanced and specialised skills associated with a subject/discipline/sector, for example:

- Convey complex information to a range of audiences and for a range of purposes.
- Use a range of standard ICT applications to process and obtain data.
- Use and evaluate numerical and graphical data to measure progress and achieve goals/targets.

CHARACTERISTIC 5: AUTONOMY, ACCOUNTABILITY AND WORKING WITH OTHERS

- Exercise autonomy and initiative in some activities at a professional level in practice or in a subject/discipline/sector.
- Exercise managerial responsibility for the work of others within a defined structure.
- Manage resources within defined areas of work.
- Take the lead on planning in familiar or defined contexts.
- Practise in ways that show awareness of own and others' roles, responsibilities and contributions when carrying out and evaluating tasks.
- Work, under guidance, with others to acquire an understanding of current professional practice.
- Manage, under guidance, ethical and professional issues in accordance with current professional and/or ethical codes or practices.

SCQF Level 9

CHARACTERISTIC 1: KNOWLEDGE AND UNDERSTANDING

Demonstrate and/or work with:

- An understanding of the scope and defining features of a subject/discipline/sector, and an integrated knowledge of its main areas and boundaries.
- A critical understanding of a range of the principles, principle theories, concepts and terminology of the subject/discipline/sector.
- Knowledge of one or more specialisms that is informed by forefront developments.

CHARACTERISTIC 2: PRACTICE: APPLIED KNOWLEDGE, SKILLS AND UNDERSTANDING

Apply knowledge, skills and understanding:

- In using a range of the principle professional skills, techniques, practices and/or materials associated with the subject/discipline/sector.
- In using a few skills, techniques, practices and/or materials that are specialised and/or advanced.
- In practising routine methods of enquiry and/or research.
- To practise in a range of professional level contexts that include a degree of unpredictability.

CHARACTERISTIC 3: GENERIC COGNITIVE SKILLS

- Undertake critical analysis, evaluation and/or synthesis of ideas, concepts, information and issues in a subject/discipline/sector.
- Identify and analyse routine professional problems and issues.
- Draw on a range of sources in making judgements.

CHARACTERISTIC 4: COMMUNICATION, ICT AND NUMERACY SKILLS

Use a wide range of routine skills and some advanced and specialised skills in support of established practices in a subject/discipline/sector, for example:

- Present or convey, formally and informally, information on standard/mainstream topics in the subject/discipline/sector to a range of audiences.
- Use a range of ICT applications to support and enhance work.
- Interpret, use and evaluate numerical and graphical data to achieve goals/targets.

CHARACTERISTIC 5: AUTONOMY, ACCOUNTABILITY AND WORKING WITH OTHERS

- Exercise autonomy and initiative in some activities at a professional level in practice or in a subject/discipline/sector.
- Exercise managerial responsibility for the work of others and for a range of resources.
- Practise in ways that show awareness of own and others' roles and responsibilities.
- Work, under guidance, with specialist practitioners.
- Seeking guidance where appropriate, manage ethical and professional issues in accordance with current professional and/or ethical codes or practices

SCQF Level 10

CHARACTERISTIC 1: KNOWLEDGE AND UNDERSTANDING

Demonstrate and/or work with:

- Knowledge that covers and integrates most of the principle areas, features, boundaries, terminology and conventions of a subject/discipline/sector.
- A critical understanding of the principle theories, concepts and principles.

- Detailed knowledge and understanding in one or more specialisms, some of which is informed by, or at the forefront of, a subject/discipline/sector.
- Knowledge and understanding of the ways in which the subject/discipline/sector is developed, including a range of established techniques of enquiry or research methodologies.

CHARACTERISTIC 2: PRACTICE: APPLIED KNOWLEDGE, SKILLS AND UNDERSTANDING

Apply knowledge, skills and understanding:

- In using a wide range of the principle professional skills, techniques, practices and/or materials associated with the subject/discipline/sector.
- In using a few skills, techniques, practices and/or materials that are specialised, advanced and/or at the forefront of a subject/discipline/sector.
- In executing a defined project of research, development or investigation and in identifying and implementing relevant outcomes.
- To practise in a range of professional level contexts that include a degree of unpredictability and/or specialism.

CHARACTERISTIC 3: GENERIC COGNITIVE SKILLS

- Critically identify, define, conceptualise and analyse complex/professional problems and issues.
- Offer professional insights, interpretations and solutions to problems and issues.
- Demonstrate some originality and creativity in dealing with professional issues.
- Critically review and consolidate knowledge, skills, practices and thinking in a subject/discipline/sector.
- Make judgements where data/information is limited or comes from a range of sources.

CHARACTERISTIC 4: COMMUNICATION, ICT AND NUMERACY SKILLS

Use a wide range of routine skills and some advanced and specialised skills in support of established practices in a subject/discipline/sector, for example:

- Present or convey, formally and informally, information about specialised topics to informed audiences.
- Communicate with peers, senior colleagues and specialists on a professional level.
- Use a range of ICT applications to support and enhance work at this level and adjust features to suit purpose.
- Interpret, use and evaluate a wide range of numerical and graphical data to set and achieve goals/targets.

CHARACTERISTIC 5: AUTONOMY, ACCOUNTABILITY AND WORKING WITH OTHERS

- Exercise autonomy and initiative in professional/equivalent activities.
- Exercise significant managerial responsibility for the work of others and for a range of resources.
- Practise in ways that show awareness of own and others' roles and responsibilities.
- Work, under guidance, in a peer relationship with specialist practitioners.
- Work with others to bring about change, development and/or new thinking.
- Manage complex ethical and professional issues in accordance with current professional and/or ethical codes or practices.
- Recognise the limits of these codes and seek guidance where appropriate.

Appendix III

Interview Script

Set 1 – Nature of Disciplinarity

1. How would you define yourself academically?
   - What criteria do you use to distinguish yourself in this way, other than by title of degree?

2. How would you define interdisciplinarity?
   - In what ways would you say that Medieval Studies does or does not qualify as interdisciplinary in terms of research or teaching?
   - Do you see interdisciplinarity as individual or collaborative, or either or both?

3. What, in your view, makes a good interdisciplinary researcher?
   - Do you think this can be learned or taught?

4. How would you define a discipline?

5. Are there particular skills or knowledge which you feel every medievalist should know?

6. Can you discuss what you think of the terms ‘truth’, ‘validity’ or ‘evidence’ in Medieval Studies?
   - Do you perceive that there is general agreement or disagreement on these notions among medievalists, or do you think the matter is more complex such as agreement at some levels but debate at others (please elaborate)?

7. Have you experienced or witnessed questionable, surface or misunderstood use of your 'home' discipline in the name of interdisciplinarity?
   - If so, do you feel this could be prevented, or should be, and if so how?

Set 2 – Nature and History of Medieval Studies

1. How would you define or differentiate the ‘medieval’ period?
   - Are there ways in which this is problematic?
   - Why do you think we make this distinction, in academic terms?

2. Do you recall when you first encountered Medieval Studies by that name?
   - How was the field different or the same then as now?
   - Do you feel that disciplinary identities/boundaries have become more important, less important, or remained mostly the same over time?

3. In an undergraduate teaching context, have ever taught in an interdisciplinary manner, such as team teaching, switching between different areas of your own expertise, or including evidence or material from another discipline in a course? (If not have you had a chance to witness other attempting this?)
   - How successful do you think this was?
   - Were the links between different 'disciplinary' inputs and sources made explicit to students, that is, where they instructed on how to relate the disciplines?
   - Would you do it again, if so what sort of changes might you make?

4. Do you think that Medieval Studies could or should be considered a discipline in its own right?

5. Hypothetically, if Medieval Studies were to be offered as an undergraduate programme, how do you think this would fit with the existing disciplines which commonly make up the field (please discuss any aspect)?
   - How would you imagine assessing student work in a Medieval Studies programme, especially a degree final project like the dissertation?

Appendix IV

Plain Language Statement

University of Glasgow | College of Social Sciences

Plain Language Statement

1. Study title and researcher details

"Disciplinarity and Interdisciplinarity in Undergraduate Higher Education: Analysis and the Case of Medieval Studies"

Principle Investigator: David Talbot (d.talbot.1@research.gla.ac.uk)

Supervisors: Dr Victoria Gunn (Victoria.Gunn@glasgow.ac.uk)
Prof. Dauvit Broun (Dauvit.Broun@glasgow.ac.uk)

For the degree of Doctor of Philosophy, Educational Studies

2. Invitation paragraph

You are being invited to take part in a research study. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part. Thank you for reading this.

3. What is the purpose of the study?

The goal of the study is to create a working definition of interdisciplinarity, and to consider if and how this might fit into undergraduate learning and teaching. My previous postgraduate work in Medieval Studies is was what gave me the idea to look at this topic. A case study of the interdisciplinary field of Medieval Studies is meant to create a 'real world' example to test the theory.

4. Why have I been chosen?

You have been approached because the needs for the case study are particular. I am interested to know the views on interdisciplinarity and Medieval Studies from lecturers in Scottish universities who teach undergraduate students in one of the cognate disciplines of Medieval Studies (History, Art History, Archaeology, Literature, Religious Studies) and are also active in Medieval Studies more broadly.

5. Do I have to take part?

It is up to you to decide whether or not to take part. If you decide to take part you are still free to withdraw at any time and without giving a reason.

6. What will happen to me if I take part?

Your participation would be for two forty-five minute interviews, preferably face to face. You are not required to travel, I will be happy to conduct the interview where you prefer. The interview will be recorded on audio only, and later transcribed. The interview will feature questions about your experiences with Medieval Studies, your views on interdisciplinarity, and your experience or ideas about undergraduate learning and teaching. You will not be asked to do anything further once the interview is completed.

7. Will my taking part in this study be kept confidential?

I recognise that the Medieval Studies field in Scotland is a close grouping, and that even general statements might be identifiable to colleagues. All information, which is collected during the course of the research will be kept strictly confidential. Your name will not be used, nor will any quotes which could in any way identify yourself, or any course, programme, centre or institution you are associated with. The data will be used to find general trends, not to look at specific examples. When the project is completed the interview itself will be deleted.

8. What will happen to the results of the research study?

The study will be submitted as my PhD thesis, and may also inform article submissions or future publication.

9. Who is organising and funding the research?

This research is organised through the College of Social Sciences, School of Education of the University of Glasgow.

10. Who has reviewed the study?

The project has been reviewed by the College of Social Sciences Research Ethics Committee, University of Glasgow.

11. Contact for further information

In addition to a contact involved in the study, it is recommended that you give a statement that if participants have any concerns regarding the conduct of the research project that they can contact the College of Social Sciences Ethics Officer by contacting Dr Valentina Bold at valentina.bold@glasgow.ac.uk

Appendix V

Consent Form

University of Glasgow | College of Social Sciences

Consent Form

Title of Project: PhD Thesis, Disciplinarity and Interdisciplinarity in Undergraduate Higher Education: Analysis and the Case of Medieval Studies

Name of Researcher: David Talbot

1. I confirm that I have read and understand the Plain Language Statement for the above study and have had the opportunity to ask questions.
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason.
3. I consent to interviews being audio-recorded.
4. I understand that copies of transcripts will be supplied to me for verification.
5. I understand that myself, my department and my institution will not be identified in relation to any statements I make.
6. I agree / do not agree (please circle one) to take part in the above study.

_____	_____	_____
Name of Participant	*Date*	*Signature*
_____	_____	_____
Name of Person giving consent (if different from participant, eg Parent)	*Date*	*Signature*
_____	_____	_____
Researcher	*Date*	*Signature*

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